Nov.

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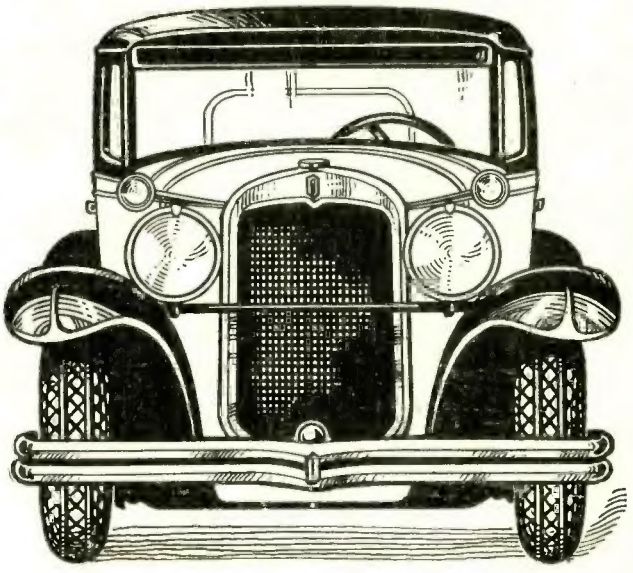

Someone who answers this ad will receive, absolutely free, a fully equipped 7-Passenger, advanced Six Nash Sedan, or its full value in cash ($2,000.00). We are also giving away a Dodge Sedan, a Brunswick Phonograph and many other valuable prizes—besides Hundreds of Dollars in Cash. This offer is open to anyone living in the U. S. A. outside of Chicago.

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Address_____

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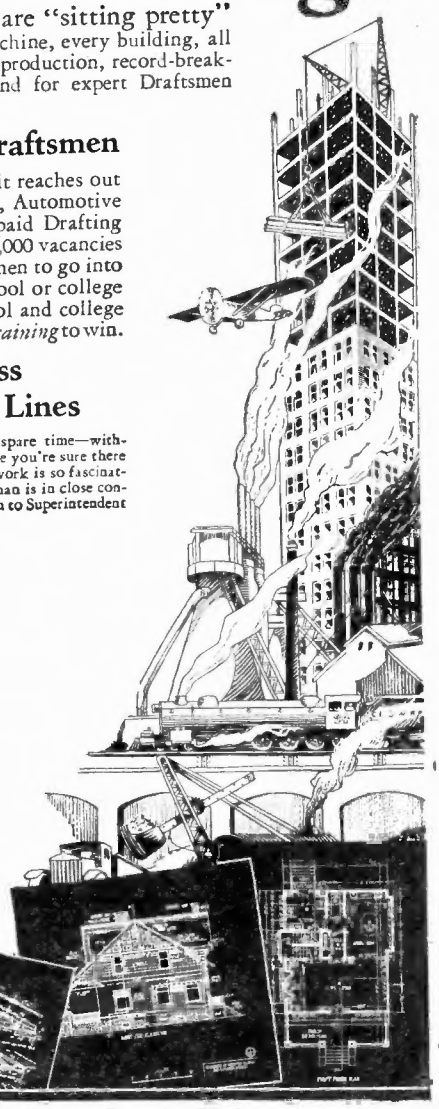

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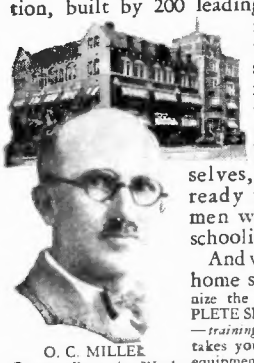

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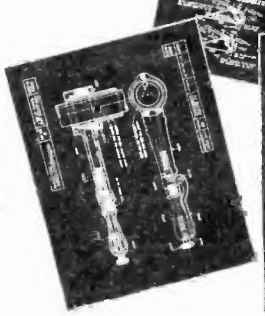

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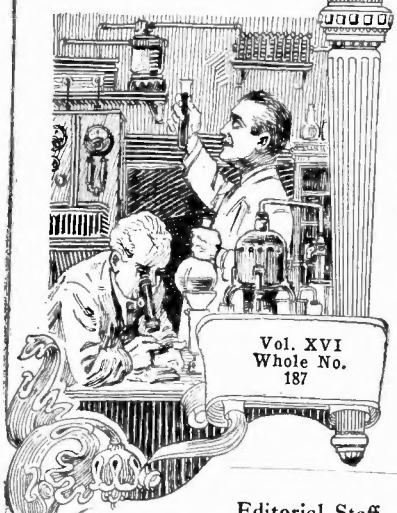

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1928
No. 7

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Television Constructor

All the latest information with clear drawings will be presented for the benefit of the television receiving set constructor.

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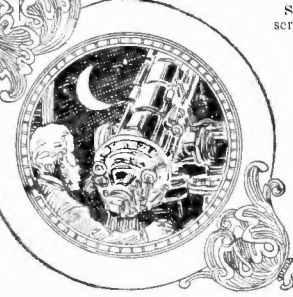

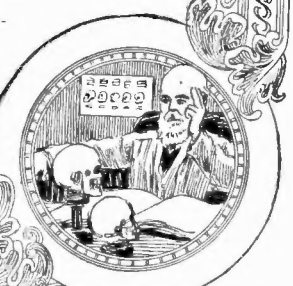

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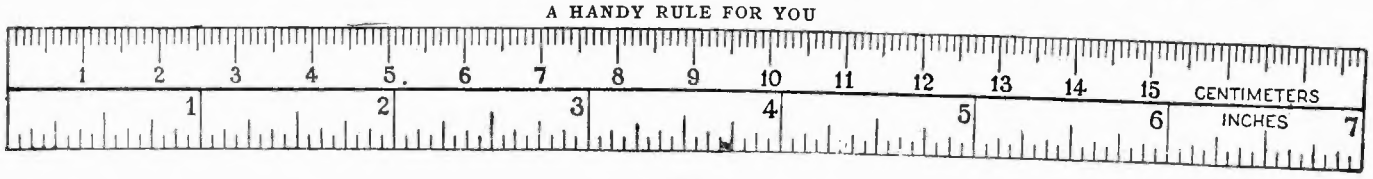

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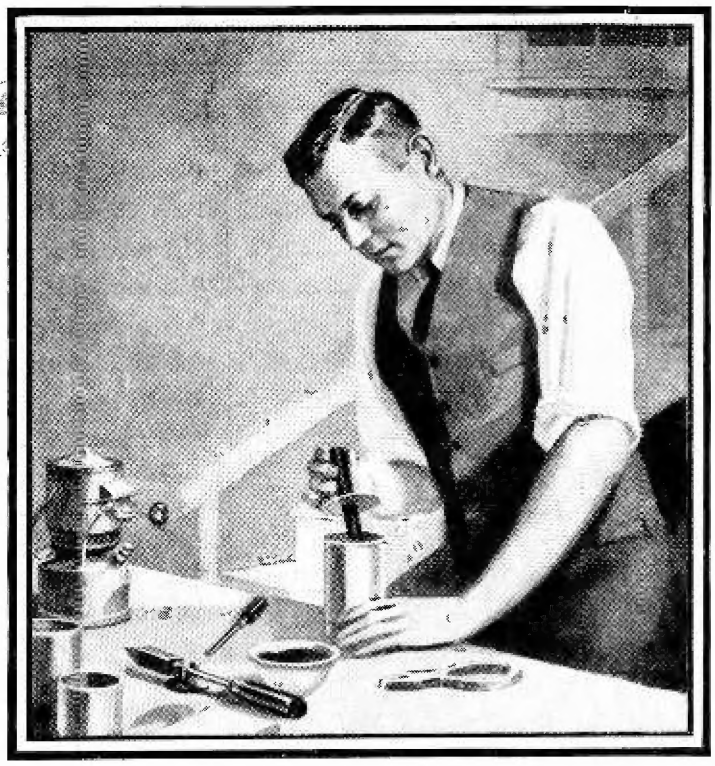

Lots of people know how to make a dry cell—but *not* the Eveready Columbia

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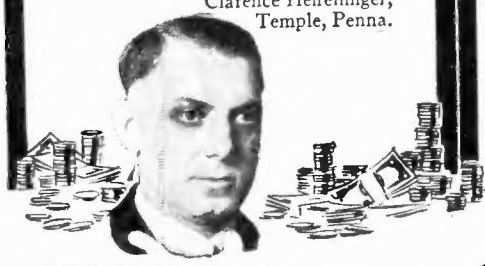

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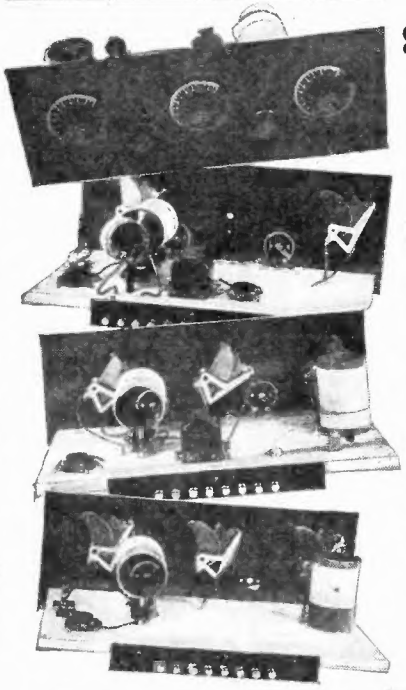

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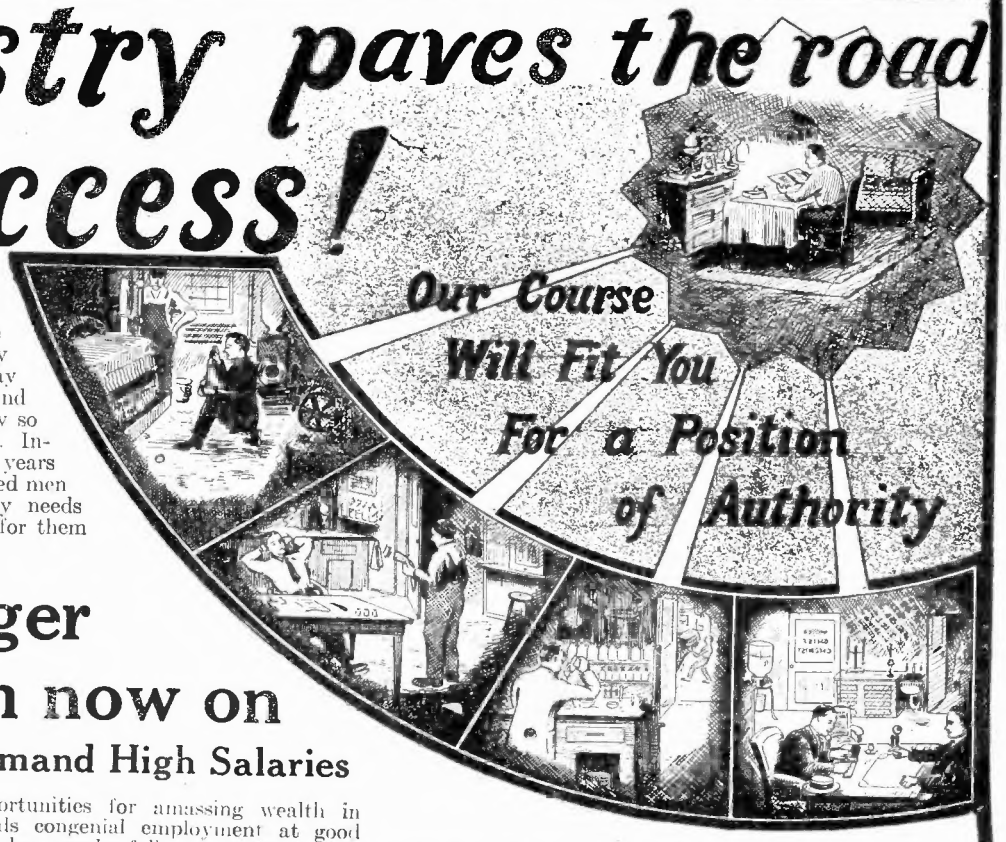

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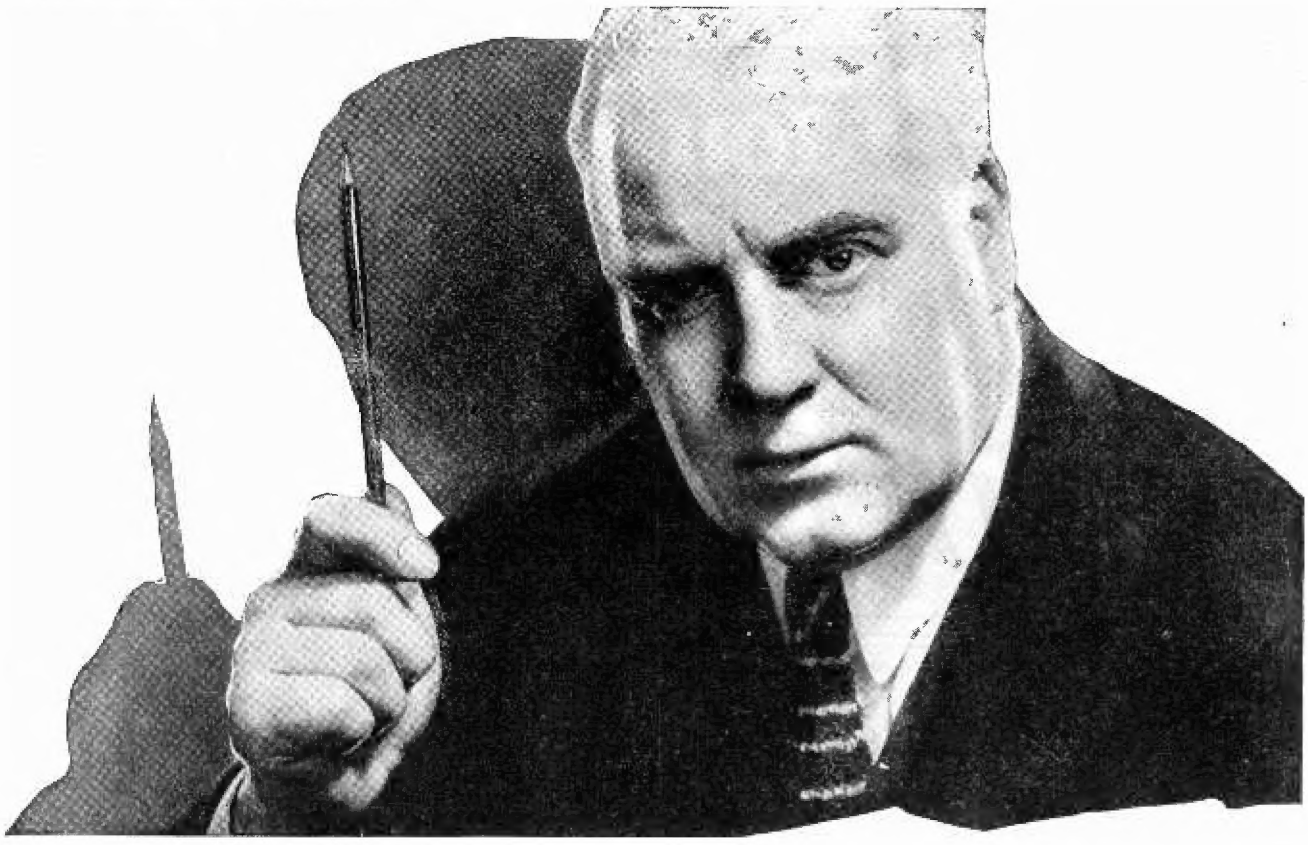

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Science and Invention

November, 1928
No. 7

HUGO GERNSBACK, *Editor-in-Chief*
H. WINFIELD SECOR, *Managing Editor*
DR. T. O'CONOR SLOANE, PH.D., *Associate Editor*
Editorial and General Offices - - - - - - - - 230 Fifth Avenue, New York

"Those Who Refuse to Go Beyond Fact Rarely Get as Far as Fact" - - - - - - - - *HUXLEY*

MAKE MONEY FROM SCIENCE

By HUGO GERNSBACK

THE most amazing and often incomprehensible fact about science is that comparatively few people make use of scientific progress. The reason for this statement is that while science and the art of invention keeps increasing by leaps and bounds, the very multiplicity of subjects makes it almost impossible for the average man to keep abreast of this progress.

Anyone familiar with patent matters often finds out that an apparently new idea in one line of endeavor, has been used for many years in another totally different field. Here is an actual occurrence to illustrate this: Years ago, a safety-razor blade manufacturer spent a great deal of time to invent and patent an automatic process in order to wrap safety blades. After a great deal of money had been expended, it was found that such a machine was already in existence and was used to wrap no less a thing than chewing gum! So today, practically the identical machinery used to wrap chewing gum is used to wrap razor blades.

A manufacturer of condensers for radio purposes expended a young fortune trying to evolve a machine to automatically wind paper interleafed with tinfoil for his condensers, only to find afterwards that an identical machine was used for many years to wind silk ribbon between paper, as is sold in most notion stores. The list is endless, and it illustrates the old statement that "One half of the world does not know what the other half of the world is doing."

While a patent is an excellent thing, and while veritable fortunes have been made from patents, it is not always a patented idea that makes money. While a patent should always be secured in order to safeguard a new invention, yet there are many processes and many devices that can be used by anyone without owning a patent. It also happens frequently that many patented inventions are ahead of progress and that the inventor does not always reap the benefit. The important art of television is a good example of this. The Nipkow disc, which is now used in all television transmitters and receivers, was invented in 1884, and even if it had been patented at that time, the patent would long have expired by this time, without benefitting the inventor, simply because the art had not progressed sufficiently.

NEW!!!
TELEVISION
DEPARTMENT
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From the foregoing it will be seen that no matter what business you are engaged in, with few exceptions, it pays to know what is going on in other branches of industry, because frequently, as I have demonstrated, one line of progress or one idea or one patent that may have expired, can be used in another line to good advantage, and steal a march on one's competitor.

This, of course, is not always apparent, and like all ideas, it must be tried out and no one knows in advance what may happen. It would seem, that to the average business man, particularly those who manufacture any commodities, knowledge of scientific progress, inventions, and patents should be a most important consideration. Yet, strange to say, very few business men ever avail themselves of such information. Of course, not every foreign idea can be used in every business, but I dare say, that there is not a single business than cannot profitably use any number of ideas from other arts and other lines of industrial endeavor.

The constant reading of all popular scientific literature and the constant perusal of the weekly Patent Gazette issued by the Patent Office in Washington will prove wonderfully valuable to practically any business. Its subscription price is insignificant—compared with its really incalculable worth to the inventor and manufacturer.

There is a tremendous market in this country for new labor-saving devices pertaining to the household. Not all of those sold at present are patented. Yet, they enjoy huge sales.

For many decades, straw hats were made in the old manner, but recently, someone came along and started to spray straw hats with a sort of varnish, when lo and behold, we have a waterproof straw hat. Here is an exceptionally simple idea that anyone could have thought of and profited by. And if it can be done with straw hats, why not other objects. The list would seem to be endless.

Another similar idea affording protection from the rain was recently offered in New York. This was nothing less than a complete raincoat and hat for twenty-five cents. Impossible as this sounds, the entire outfit offered only for emergency purposes at theater entrances, is a small package, neatly folded in an envelope. When unfolded, we have a wax paper raincoat and hat, which can be worn a few times and then discarded. A simple idea that anyone could have thought of and made money from. The idea, as far as we could ascertain, was not even patented.

In talking about waterproofing, they are now making ladies hose waterproof by means of a special process. It should prove a good seller. Somebody could reap a fortune by getting up a formula to varnish or impregnate newspaper as it comes off the printing press. While not so important for newspapers, it is of great importance to magazine publishers who publish magazines on ordinary newsprint stock. This paper, as a rule, does not last more than a few years; after that it falls to pieces. If some cheap varnishing arrangement could be devised to attach to a press, after the magazine is printed, and as it comes off the press, a large fortune could be made if the process was simple and cheap enough, as most publishers would then avail themselves of the idea.

If someone has a great deal of time on his hands, nothing would pay better than to make a comprehensive catalog of all the *waste-products* in this country, and then try and commercialize them. Years ago, gas plants threw away all of their coal tar. This, today, is the most valuable product and often more valuable than the main product, that is, the gas.

But what about the exhaust of our automobile? There is a good deal of combustion going on that might be saved and turned to some profit. Sawdust used to be thrown away, or given away free. Today, every lumber mill and every woodworking plant sells this former waste-product at a good profit, because it is used for many purposes, such as artificial wood and processed wood objects.

Years ago, the sauerkraut industry threw away their by-product, which was the juice or liquid, and for which, no one could find a use. At the present time it is bottled and sold as sauerkraut cocktail, which is a wonderful intestinal stimulant and is growing in popularity by leaps and bounds. It begins to look as if sauerkraut juice will become more valuable than its parent.

Every family throws away tons of loose newspapers and magazines every year. It is true, that a large percentage of this finds its way to the paper mills, there to be used over again. But it seems that there should be other and more important uses for news and magazine paper after it has served its purpose.

The list of such waste-products and waste articles is endless. Fortunes are in store for those who solve these problems.

Mr. Hugo Gernsback speaks every Tuesday at 9.30 P. M. from Stations WRNY (326 meters) and 2XAL (30.91 meters) on various scientific subjects.

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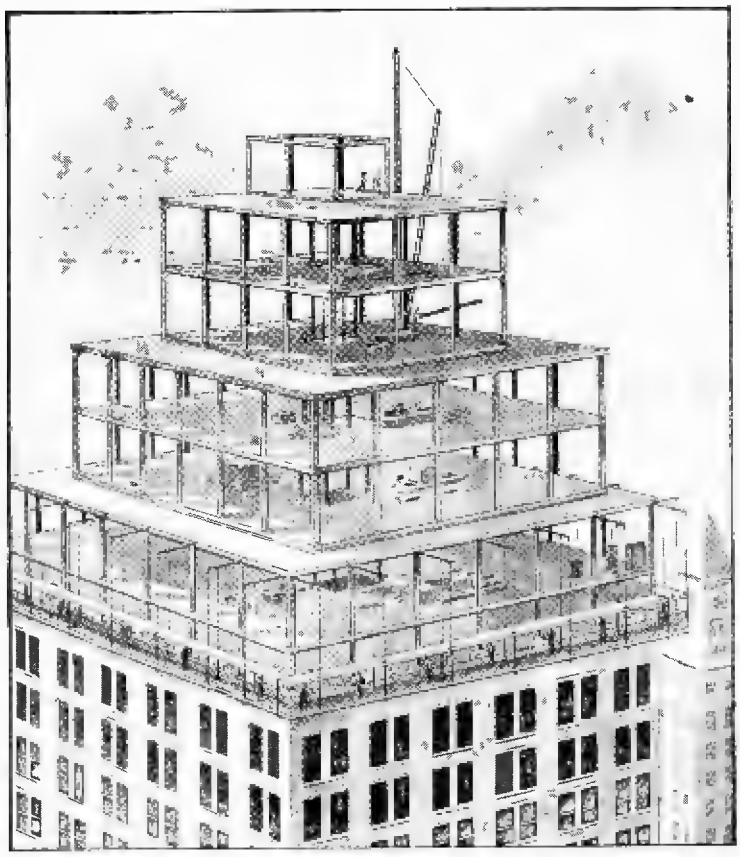
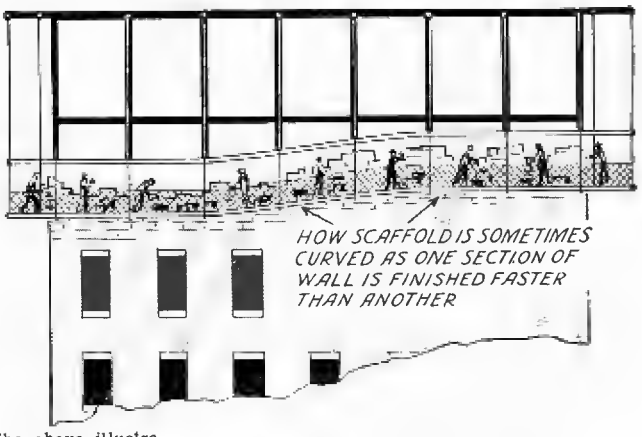
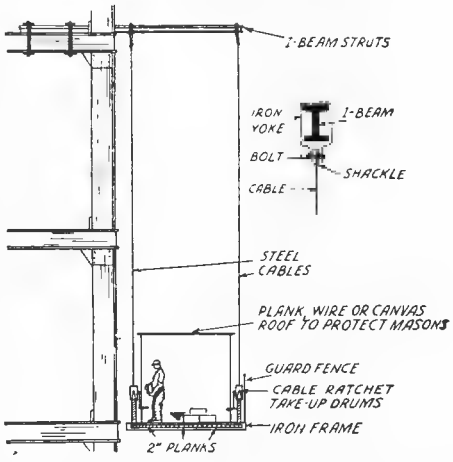
Moving Scaffolds Aid Masons

Stone and Brick Work Placed on Skyscrapers in Record Time; Masons Follow Iron-Workers





The above illustration shows how the scaffolds can be curved as one section of the building is finished faster than another. The drawing at the right shows how the platforms are moved by means of hand winches.



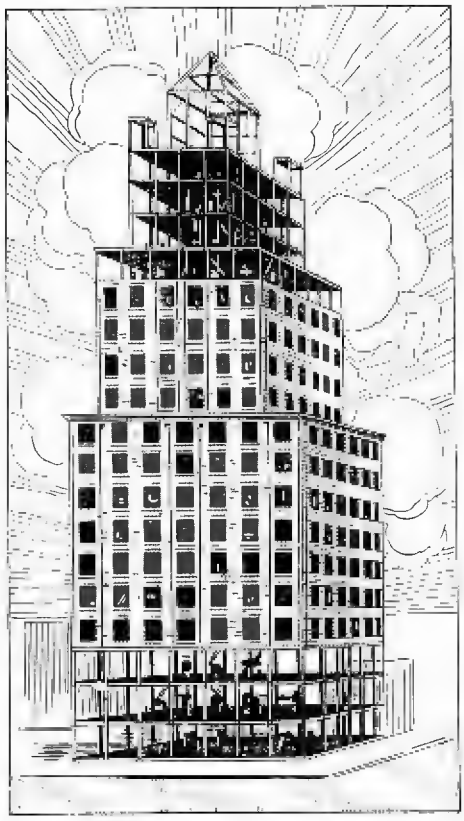
The scaffolds are placed entirely around the walls of the building, and are cleverly joined to each corner The illustration at the left shows these moving platforms being used in the construction of a large skyscraper. A roof is provided to protect the workers.

IN our present-day Machine Age, engineering and architectural development is rapidly advancing. In all big cities skyscrapers are springing up like veritable mushrooms. As each day passes, new construction methods are invented to keep in step with the modern building design. Recently, moving safety scaffolds have been put to use in the erection of the large buildings and have greatly aided the masons in applying the stonework. The new scaffolds are made of planks supported by an iron frame and are roofed over with boards, wire or canvas to protect the workmen from objects falling from above. A heavy wire frame around the edge of the scaffold assures protection to the pedestrian and safety for the workmen. To further insure the pedestrian's safety, the sidewalks are roofed over.

The scaffolds are suspended with steel cables from I-beam struts from a portion of the building framework. A series of winches placed at the front and back edges of the mason's platform permits it to be raised or lowered by the workmen. As one portion of the wall is finished, the scaffold is raised by simply operating the lever on the hand winch. Sometimes one portion of the wall is finished faster than another. This condition is illustrated here, and it will be seen that the scaffold can be bent or curved at will. On one large building which the editors watched from the window, the scaffolds assumed a double curve frequently during the construction. The moving platform or scaffold permits eight or ten floors to be finished without changing the position of the cables. When the stonework has been put on the maximum number of floors, the cables are removed and placed higher up on the building.

Another interesting point in the erection of a skyscraper, is the placement of the construction elevators which lift the bricks and materials, which cannot be carried from the street level. These elevators are built just as soon as a steel skeleton has been started, and keep pace with the growth of the structure. The heavy elevator motors, water tanks, and other materials, are raised to the upper floors of the building by a steel boom derrick before the masonry is put on.

The contraction and expansion in the outer masonry walls of the building is taken care of in two ways. The brick or stone wall is divided up into a number of sections by the steel skeleton construction. Besides this, flexible cement is used at each floor line where the floor girders join the uprights. Before the masonry is put in place, tar paper and tar are used to waterproof the steel work and prevent water from reaching it and becoming pocketed. It is interesting to note that any section of the outer brick or stonework can be removed without causing a collapse of the building. This is made possible by the steel construction of our modern buildings. Forty years ago the floors above the street level were supported by brick or stone walls and towers. In the older buildings, which had from ten to twelve stories, the huge supporting walls took up an enormous amount of space on the lower floors. The present-day steel skeleton supports the whole weight of a skyscraper, and the stone or brick masonry simply covers it, but does not bear any part of the weight. The illustration at the bottom of the page will show this and illustrates how the masonry work is frequently put in place on the upper stories before it is applied to the lower floors. Detailed information on modern skyscraper erection will be found in an article entitled, "Why is a Skyscraper?" by H. W. Secor, in the August, 1928 issue of this magazine.



The illustration at the right shows how the steel skeleton of a building is filled in with the stonework at any desired floor. With the old type of masonry construction, where the walls supported the weight above them, this would be impossible, and the masonry would have to begin from the bottom.

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Television Directs Two Orchestras

Leader's Picture on Screen Keeps Two Bands in Time

FRITZ REINER, the conductor of the Cincinnati Symphony Orchestra, plans to put television into practical use in the conducting of two orchestras. The latest invention will be employed in the playing of Mahler's Symphony No. 2, where, in the last movement, a full orchestra and a small orchestra are needed for the proper rendition of the selection. The score requires that the sound of the small orchestra shall reach the listener but faintly. Heretofore, an assistant director, stationed behind the stage, conducted the second orchestra as he watched Mr. Reiner through a hole in the wall. It is planned to have his picture, time and placement, thrown on the screen in the room where the second orchestra will be stationed, thus enabling it to keep exact time with the main body of musicians. Furthermore, the tones of the hidden orchestra will assume a remarkable reality of faintness and distance.

The above drawing shows how a hidden orchestra will be kept in time with the main symphony orchestra by means of television. The conductor's movements will be thrown upon a screen in front of the hidden orchestra.

The leader of the orchestra will be televised and his picture thrown upon a screen, keeping both bands of musicians in the same tempo. This is to be put into effect during a concert given by the Cincinnati Symphony Orchestra.

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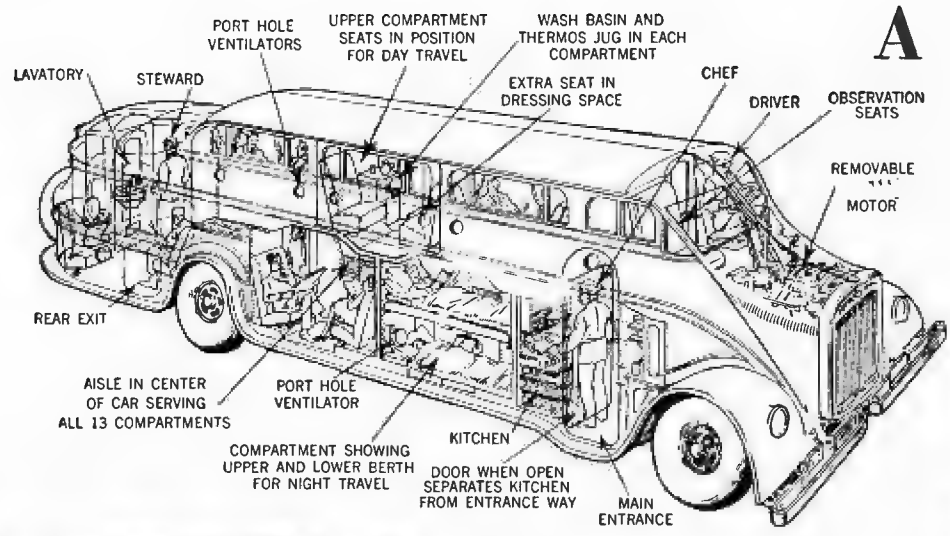
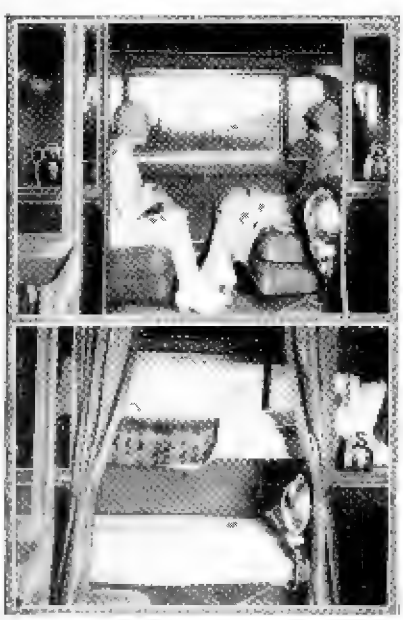
A MOTOR BUS SLEEPER

Now Possible to Travel Across United States at last on Buses Carrying Sleeper Berths and French Chefs

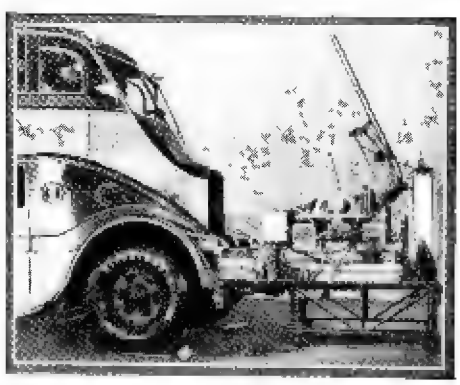




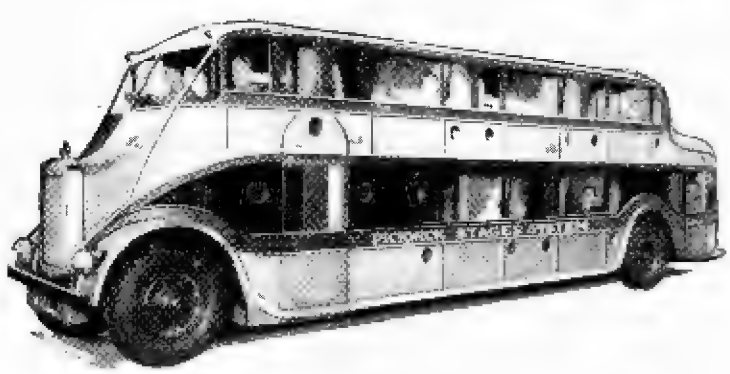
THE ultimate idea in motor bus construction has been reached with the introduction of a night coach, which provides sleeping quarters for twenty-six passengers. The compartments are arranged in upper and lower decks, and each accommodates two people. At night the cushions of the seats are used to form the berths. The bus is 34 ft. 6 in. long, 8 ft. wide, and 10 ft. 3 in. high. It weighs 14,000 lbs. and was built at a cost of $30,000. The coach is constructed entirely of metal and has no chassis. A heavy frame of steel around the car just below the lower berth windows serves as a chassis.—*Photos courtesy Pickwick Stages System.*

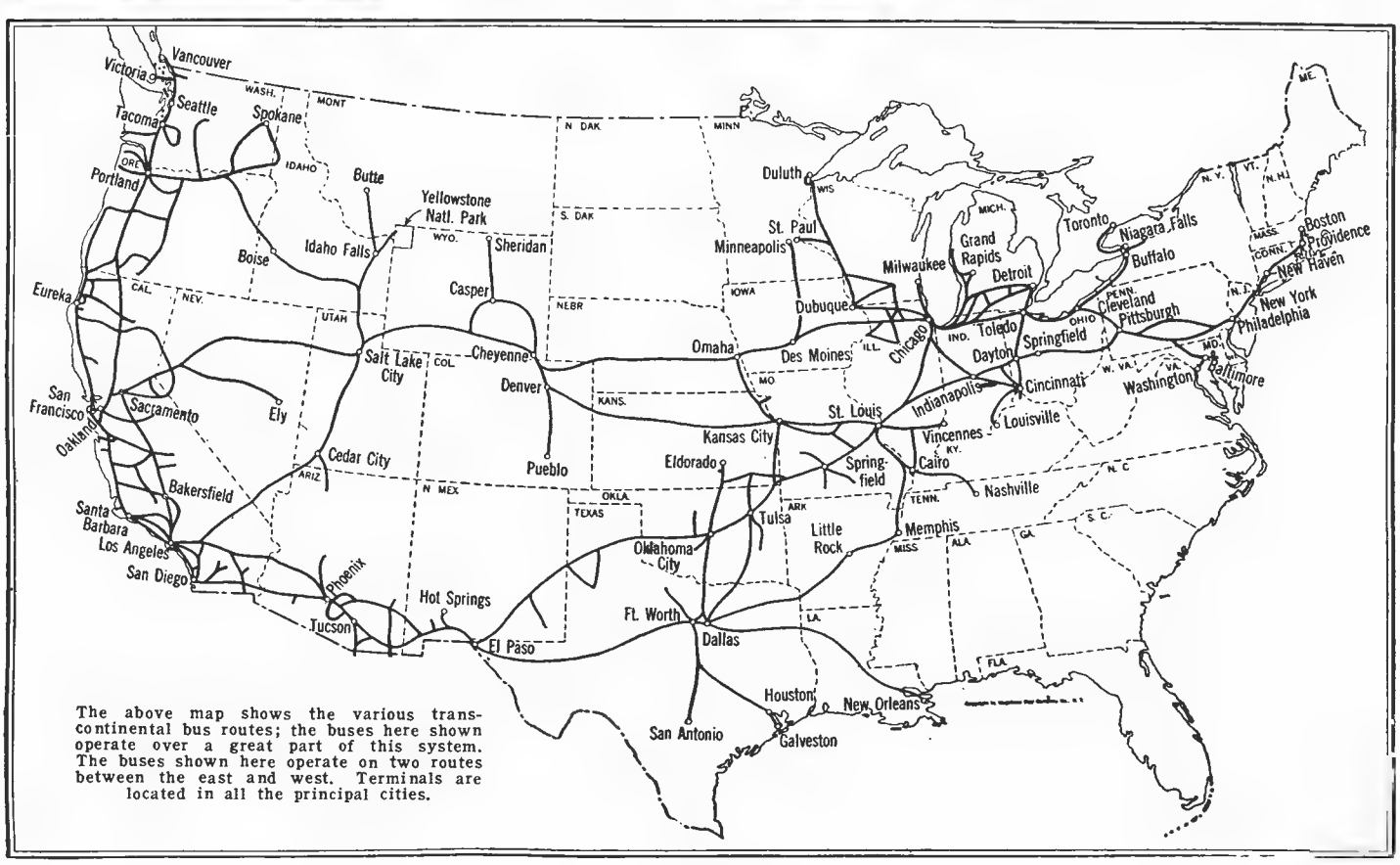
The photographs at the left show the passenger seats in normal use and when the berths are made up. At the right is a photo of the new motor stage.

The illustration at the top of the page shows the internal construction and how greatest comfort is provided in a minimum of space by clever engineering design.



A remarkable new feature of the bus lies in the fact that the motor can easily be removed for repair, as shown above.





The above map shows the various transcontinental bus routes; the buses here shown operate over a great part of this system. The buses shown here operate on two routes between the east and west. Terminals are located in all the principal cities.

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The Month's Scientific News Illustrated

By GEORGE WALL

Jean A. Lussier recently went over the Horseshoe Falls at Niagara Falls in a huge rubber ball. He is the third man in history to accomplish this death-defying feat. The ball was of special design and was made according to his own design and weighed seven hundred pounds. Lussier started his trip three miles up the river and traveled that distance, including the drop of the falls, in 50 minutes. When the ball was reached after the trip, it was right side up, and only a few minutes time was required to open it, because of the specially constructed lid. The passenger suffered only minor bruises in his perilous journey and all were received in the terrific bouncing which was experienced while going over the rapids. The above illustration shows the construction of the ball which was fitted with a ballast and an air vent.

Two buildings in Washington, D. C. were burned to the ground in order to obtain scientific data. The unusual fire was part of a series of tests being made by the Bureau of Standards in order to obtain accurate information of fire prevention. Observations were taken from a dug-out in a boiler room nearby, and by means of thermo-couples the temperatures were measured. Estimated temperatures of 3,500 degrees Fahrenheit were obtained. Thirty-five safes in different parts of the building, numbered for identification, held thermometers and useless records so as to determine the degree of protection afforded.

Recently, at Tracy, California, an airplane was brought to earth with a huge parachute, as illustrated above. Only slight damage was done to the plane, which was allowed to fall from a height of 2,000 feet. The pilot released a small parachute, which in turn unfolded a larger one. Failure of the smaller parachute to open quickly nearly ruined the experiment. The plane began to spin and the pilot was prepared to leave it, when the ropes untangled.

Motion picture films can now be retouched much the same as portrait negatives are at the present time. A French patent makes provision for retouching movie films by looking at the projected image and the image of the retouching pencil. In this manner many small details can be treated. The apparatus is the invention of L. H. Burel and H. Debain.

For the first time in aviation history an army dirigible successfully landed mail on the roof of a speeding train. Army officers maneuvered a 200-ft. non-rigid ship down on top of a mail car roof after a chase of thirty-five miles. In spite of the speed of the train, the dirigible maintained its position long enough to permit the transfer of a sack of mail, and to demonstrate the possibility of air-to-land transfer. Cameras were carried in both dirigibles and moving pictures were taken while the stunt was carried out. During the chase the dirigible traveled at a high rate of speed directly above the train tracks. On one side of the tracks were strung telephone wires, while on the other, ran high tension power lines. The airship traveled between these electric walls and almost came to grief when one of the trailing cables swept a high tension line. In spite of the air currents set up by the train, the dirigible finally managed to catch the train and drift above it.

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How Lindbergh's Famous

A Trip Through the Manufacturing Plant Where

By H. W.

THE writer recently had the pleasure of visiting and being conducted through the up-to-date manufacturing plant that turns out the air-cooled aircraft engines of the type made famous by Col. Lindbergh in his memorable flight from New York to Paris. Since that time this same engine has become famous throughout the world, it having been used as the power plant on most of the trans-oceanic flights, whether over the Atlantic or the Pacific.

The air-cooled engine is the logical one for airplane propulsion, owing to the fact that no water has to be carried for cooling the cylinders. There are also a number of other important factors such as a reduction in the weight of the plane itself, when it is designed for use with an air-cooled engine. The Whirlwind engine, made famous by Lindbergh and other notable pilots, confuses many people when they first see pictures of it, as it somewhat resembles the old Gnome (French) rotary engine on which the cylinders revolve. In the American built air-cooled engine here under discussion, the cylinders are stationary, but are air-cooled by the great rush of air past the cooling fins on the cylinders and on the cylinder heads.

So popular has the new air-cooled engine become that this concern, whose plant is located at Paterson, N. J., is now carrying out a new five million dollar expansion program and large new factory buildings are at present being erected. It is interesting to note that during the month in which Col. Lindbergh made his famous hop from New York to Paris, only 35 of these engines were turned out at the factory; in June of this year, 138 engines were turned out; in July, this had been increased to 150; and by December 1928, 250 engines will be turned out each month. The officials of the concern stated that when all their new factory buildings have been completed the monthly production of air-cooled engines will be 500 engines.

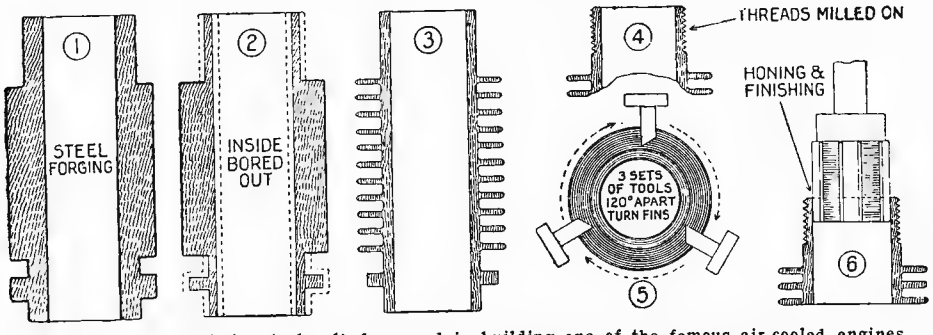
Most of the parts on the modern air-cooled aircraft engine of the type here being considered are made of an aluminum alloy, which possesses nearly the same strength as mild steel, while the weight is only slightly greater than that of aluminum itelf. Many difficult problems were encountered at first in melting and molding the aluminum alloy, as aluminum is a very peculiar metal. Only the highly stressed parts of the engine are made of steel, the members made of this metal being principally the cylinder sleeve and cooling fins, the connecting rods and crankshaft, all gears and the valve rocker arms.

HOW THE CYLINDERS ARE MADE

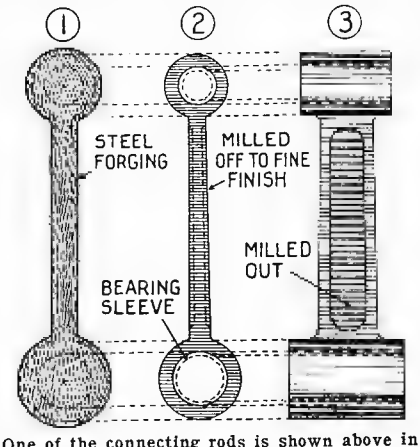
ONE of the accompanying illustrations shows the progressive stages through which one of these air-cooled engine cylinders passes from the time it arrives at the receiving department of the plant in the form of a steel forging. As may be surmised, a considerable part of the metal is eventually machined off of the original forging by the time the finished cylinder and its cooling fins are formed. One of the first operations on the steel forging which will eventually form one of the nine engine cylinders, is that of machining the ends as shown at 2 in the accompanying diagram. This provides an accurately finished part of the casting on which the successive machine operations are based or keyed. As a preliminary operation, the inside of the steel sleeve is bored out. After passing through several tooling stages, the smoothly finished shell still lacking its cooling fins, is gripped in a special lathe by an internal expanding chuck and as will be seen in stage 3, the cooling fins, each one of which is only 3/64ths inch thick, are cut from the solid steel forging by a triple set of tools as the picture shows. Each one of the three sets of tool holders holds a set of tools equivalent in number to that of the grooves on the cylinder.

One of the next operations after the cooling fins have been turned on the solid steel forging is that of cutting the threads on the upper end of the cylinder onto which, later, the cast aluminum alloy cylinder head will be screwed and shrunk. The threads on the upper end of the cylinder are not cut by means of a die or lathe tool, as the mechanically inclined reader may surmise. The threads are *milled* on the steel cylinder sleeve by a milling cutter, the cutter and the steel sleeve revolving in opposite directions. The milling cutter revolves at high speed, while the steel cylinder makes but one revolution while the threads are being put on.

Finally the cylinder sleeve, after being carefully inspected and checked (this checking with micrometers or specially prepared gauges occurs after each successive machine operation) passes to the end of the machine shop where the cylinder head is screwed and shrunk into place and where it is honed by a revolving honing tool, which slides up and down inside the cylinder, while it simultaneously revolves. When the cylinder is finally finished, the inside is as smooth as a mirror, and ready for operating service.



Evolution of one of the steel cylinders used in building one of the famous air-cooled engines used by Colonel Lindbergh in his flight from New York to Paris. The steel forging is partly machined, and then the cooling fins are turned on the exterior of the steel shell (3), by means of a special lathe containing three sets of tools placed 120 degrees apart. Cap threads on the cylinder are milled on (4), and the cylinder is then honed and polished (6).



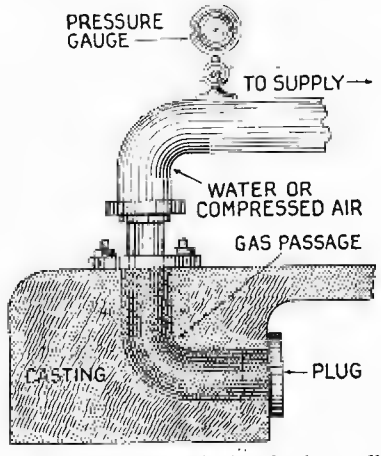
One of the connecting rods is shown above in its evolution from a heavy steel forging to the finished part, the metal removed representing nineteen-twentieths of the original forging.

THE CONNECTING RODS

THE connecting rods in the air-cooled engine are very strong, yet relatively light. They are not made of aluminum but of a steel forging, as one of the diagrams herewith shows. In this particular engine the connecting rods are machined all over and represent a very fine specimen of the machinist's art when finished. The round ends are milled off in a milling machine and for that matter so are the sides and the countersunk portions on two of the sides. The two bearing ends of the connecting rods are drilled out and then reamed out. Afterward suitable bearing sleeves are shrunk into the ends. The amount of metal machined off of the forged steel connecting rod may be quickly perceived when it is said that the finished rod weighs only about 1/20th as much as the rough steel forging. As in the case of the cylinder machine operations, the connecting rods are checked repeatedly as they progress through the various manufacturing stages.

HOW CASTINGS ARE TESTED

THE aluminum alloy castings constituting the main crankcase sections of the engine are quite complicated, so far as the foundry work is concerned. The molder who undertakes this class of work has to be a real



All passageways through the aluminum alloy castings are tested either with water or compressed air, any leaks due to cracks or sand holes being indicated on the pressure gauge.

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Engine Was Manufactured

the Air-Cooled Engines Are Designed and Built

SECOR

expert in this line, as the cores as well as the molds are very intricate and a number of passageways for gas and oil are cast integral with the crankcase.

The passageways for oil, gas, etc., in the castings are tested by means of water and in some cases by means of compressed air, as one of the accompanying drawings shows. One end of a passageway is plugged up and water under pressure, or else compressed air is applied to the other end of the channels or channel. A pressure gauge connected to the water or air system shows any leakage in the passageways and as a reduction of the pressure occurs, the casting is inspected for cracks or air holes. If any fault is found, the part is rejected.

CYLINDER HEADS SHRUNK ON

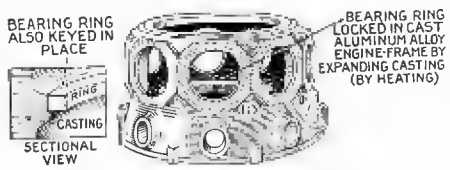
UNLIKE the ordinary automobile engine, which has the cylinder head cap bolted in place with a gasket between it and the cylinders, the cylinder heads on this air-cooled aviation engine are shrunk and screwed on. These cylinder heads are heated in an oven as shown in one of the illustrations herewith, so that they expand sufficiently to enable a mechanic to screw the cylinder head on to the threaded end of the steel cylinder sleeve. The cylinder sleeves are not cooled in any special manner, but are left at room temperature, or about seventy degrees Fahrenheit. When the aluminum alloy head castings, which of course have been machined and finished previously, are heated in the manner explained, they expand several thousandths of an inch, and it is then an easy matter to screw them in place on the cylinder. In this way an extremely tight joint is effected between the cylinder and its head. In the Whirlwind engine the valves are mounted in the head of the cylinder, there being one exhaust valve and one intake valve. These are mounted at an angle, so as to give the largest cooling area possible between them. The engineers who have developed the design of the air-cooled engine of the type here being described, have performed a wonderful service which aviators everywhere are thankful for, particularly in the design of the valves and the lightness of the engine, its superior power for a given weight, and the extremely strong cylinders and cylinder heads. It will be remembered that in some of the early flights cylinder heads now and then had a habit of blowing off and, happily, just missing the pilot.

PISTON AND RINGS

ALL automobile engine enthusiasts will be interested presumably in the style of the piston and the piston rings used in the remarkable engine made famous by Lindbergh and other notable pilots. The Whirlwind motor has aluminum alloy pistons which are cast and then very carefully and accurately machined to size. As in regular gasoline engine design, the pistons are turned a few thousandths of an inch smaller than the bore of the cylinders, and when the engine is assembled, the four piston rings are placed on the piston before it is inserted in the cylinder. Three hammered cast iron rings are placed on each piston together with one oil wiper ring. As shown in one of the pictures herewith, every piston ring is tested, both for its physical dimensions and also for its resilience or springiness. A very simple arrangement worked out by one of the factory engineers, and utilizing a standard weighing scale, together with an upright arm and a lever, enables the inspectors to push down on a piston ring, and when releasing the lever, the spring rebound caused by the resilience of the ring is read on the scale indicator. This rebound is usually about eight pounds.

While being shown through the plant recently, the writer was handed a finished piston which had been rejected by one of the inspectors after being machined. It was practically impossible to find any flaw in the aluminum alloy piston which might have caused the inspector to reject it. A tiny hole about one-fourth the size of a pin head was finally pointed out on the lower edge of the piston, and for that tiny defect the inspector had rejected the piston and dispatched it on its way to the scrap pile. This will give some idea as to the rigid inspection of the parts used in this famous motor.

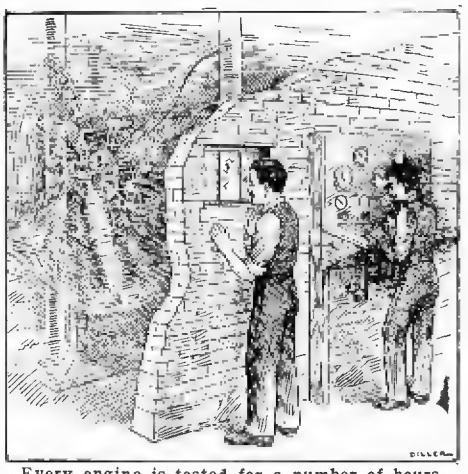
The engine crank case has a number of bronze bushings or bearings fitted into it and these are shrunk into place in a similar manner to the shrinking of the cylinder heads into position. The aluminum alloy casting constituting the crank case is heated, which expands the hole, and the bronze bushing is then dropped into place. To make sure that these bushings will not become loose at some later date when the engine is in use on an airplane, they are also keyed with a small steel pin driven into place between the bronze bushing and the alloy casting.


BEARING RING ALSO KEYED IN PLACE
RING
CASTING
SECTIONAL VIEW
BEARING RING LOCKED IN CAST ALUMINUM ALLOY ENGINE-FRAME BY EXPANDING CASTING (BY HEATING)

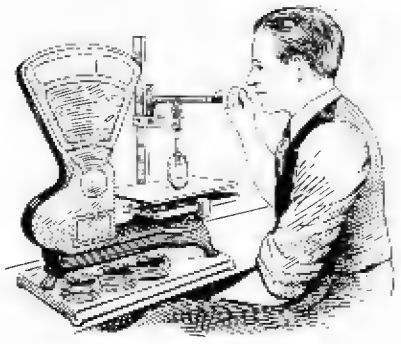
Bearing rings are shrunk into the engine casting, and they are also keyed, so that if they should become loose they cannot get out.

TESTING THE ENGINES

IF you have never visited an aircraft engine plant, you will have practically no idea as to the noise the engines make when they are placed on the testing block. On the writer's recent tour of the plant at Paterson, N. J., where the Whirlwind engines are built, it was quite a surprise to hear the tremendous roar these engines make when they are on test. About a dozen of the 225 horse-power engines were being tested, together with one of the new models, known as the Cyclone, which develops 525 horse-power. The engine test buildings are small brick affairs with extra thick walls. The engineers in charge of the tests are stationed in small instrument rooms, the instrument rooms and the engine compartments being placed alternately along in a row. Large iron pipe manifolds are provided, into which the exhaust pipes of the various cylinders from the motor are connected. The exhaust gases are carried through the large manifolds and the connecting pipe system, so that the discharge takes place eventually about thirty feet in the air, just to the rear of the test rooms.



Every engine is tested for a number of hours before it is shipped. Accompanied by a mighty roar the engines are put through the third degree, the engineers checking the fuel consumption, temperature, and other factors every few minutes.

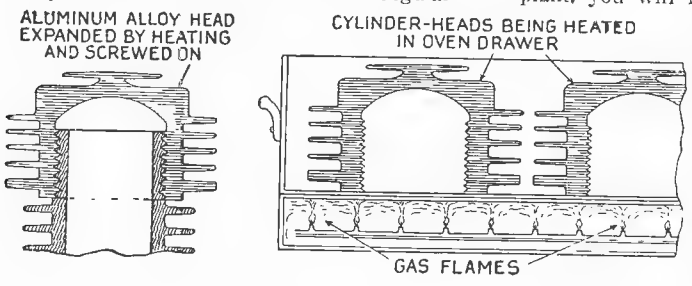


Every piston ring is accurately tested.

The engineers can keep a sharp eye on the engines while being tested for hours at a time through heavy glass windows placed in the thick brick walls separating the engine compartment from the instrument room. On the wall of the engineers observation room, there are a host of instruments indicating the speed of the engine, the temperature of the oil and air, the revolutions per minute and other important factors, all of the meters being read every few minutes and this data tabulated by the engineers on a special report sheet. Stop watches and slide rules are also necessary in making up the reports, and so great is the continual roar of the engines that the engineers usually wear special ear protectors, similar to those used by the artillerymen during the World War.

It is almost impossible to describe the tremendous roar of the mighty Cyclone 525 horse-power air-cooled engine, which the

(*Continued on page 637*)



One of the most interesting operations in the manufacture of the air-cooled engines is that involving the placement of the cylinder heads. The aluminum alloy head casting is heated in an oven, as shown at the left. When heated and thus expanded to the proper degree, they are screwed on cylinder.

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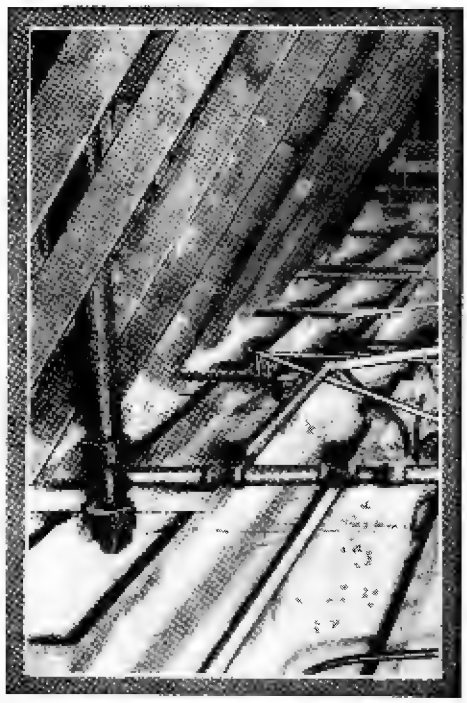
How to Save Coal!

By C. D. KEELY

Above—dry insulation being poured behind the gypsum wall board.

SHORTLY before he died, Charles P. Steinmetz, the Electrical Wizard, said: "Our present structures are causing annual leakage costs of literally millions of dollars worth of heat. The home of the future will be scientifically built from the standpoint of heating." A statement, equal in significance to that of Mr. Steinmetz, has been made by the Bureau of Industrial Research, Washington, D. C. This is the statement: "The fuel consumed in 15,000,000 homes in northern states is fully 30 per cent, and probably 50 per cent more than would be necessary if standards were maintained in materials. Many homes in America have a fuel cost equal in twenty-five years, to the first cost."

Explanation for the emphasis now being placed, by homebuilders, contractors and architects, on the necessity for thermal insulation of residences and other buildings is to be found in the two statements just quoted. Dr. Steinmetz said that heat losses are costing America millions of dollars every year; the Bureau of Industrial Research, says that some 30 per cent of the fuel consumed in northern homes is wasted. Heat, which is fuel, is money. Hence the recent development of thermal insulation,

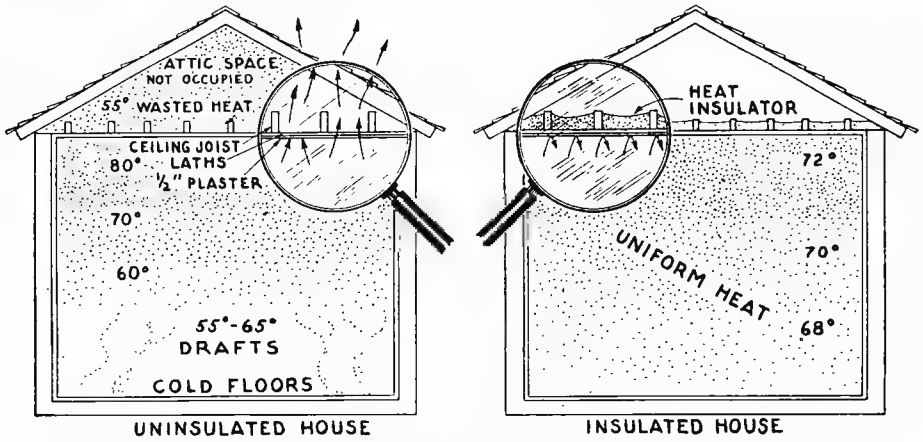


Dry fill insulation is placed between the attic joists. Note pipes imbedded in insulating material.

which has for its aim the utilization, the saving, of a part of the heat that is lost from uninsulated structures.

THERMAL INSULATION

No convenient definition for thermal insulation is to be found. Thermal, however, means pertaining to heat; and insulation means isolation. Thermal insulation, then, can be taken to mean, the isolation of heat;



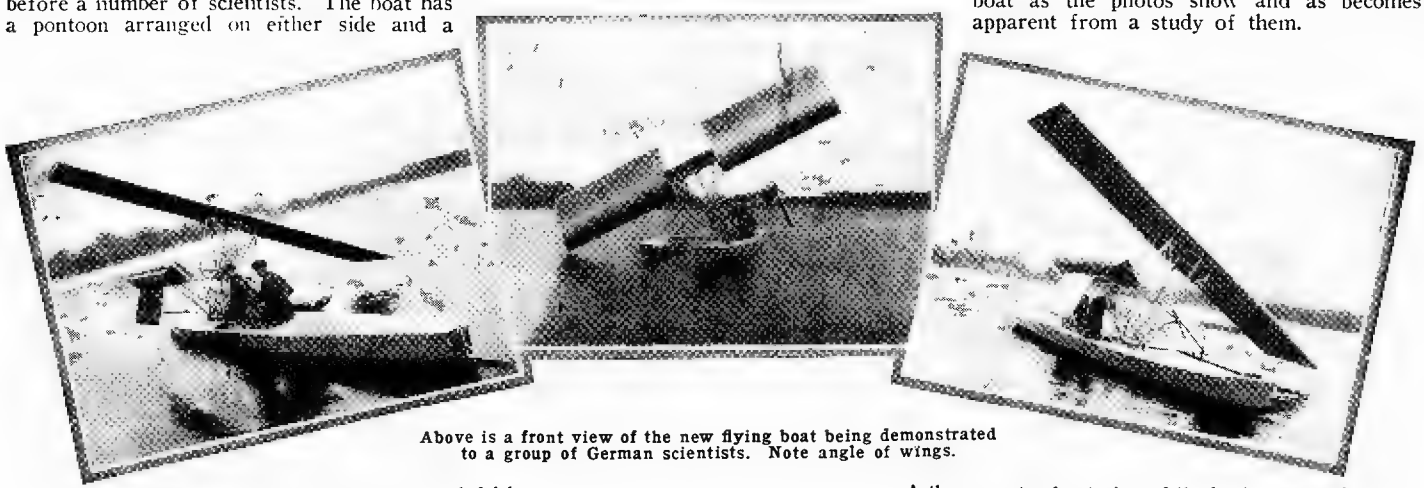
The efficiency of an insulated and an uninsulated house is compared in the above illustration.

and an insulated building can be described loosely as one in which the heat, generated in the heating plant, is isolated. It is not, of course, desirable to entirely isolate heat in any building. A condition of perfect isolation would not be a healthy one. Nor is it practicable to attempt perfect heat isolation, for the reason that inevitable avenues of heat-escape, such as doors and win-

(*Continued on page* 669)

A Flying Sailing Boat

A BOAT which resembles an airplane more than it does an aquatic craft has recently appeared in Germany. It is the invention of Friedrich Budig who is shown in the photographs demonstrating the craft before a number of scientists. The boat has a pontoon arranged on either side and a wing which moves from right to left under the power of the operator. In changing its course the boat relies upon change in wind pressure which is accomplished by tipping either the right or left half of the wing in much the same manner as is done with airplane ailerons. The photograph in the center shows how the wings may be tipped up or down by the operator. The usual type of rudder aids in steering the boat as the photos show and as becomes apparent from a study of them.



Above is a front view of the new flying boat being demonstrated to a group of German scientists. Note angle of wings.

The illustration above shows the inventor, Friedrich Budig, seated in his novel craft.

A three-quarter front view of the boat appears above. In appearance it resembles an airplane.

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Entertaining with Hypnosis

Astounding Yet Harmless Thrills Which You Can Accomplish. Your Friends Will Be Surprised

By KENA MURAY

Here the subject is commanded to twiddle his thumbs and then told he cannot stop. He continues the thumb movement because he cannot do otherwise.

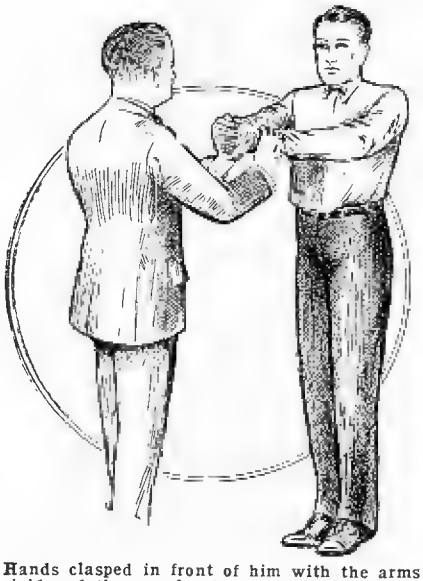
IT is the purpose of this article to explain, in as simple language as possible, a few of the inner secrets of entertaining with hypnotism so that the reader, without special training or inclinations in this direction, can easily present experiments of a humorous and scientific nature that are sure to mystify and entertain at parties and social gatherings.

It is first important that the reader understand that no attempt is made to acquaint him with the deeper truths of this science. Rather, for the purpose, it is merely desirable that we skim the surface wherein no special ability or training are necessary, and the reader is cautioned against attempting to delve further into this work, beyond the experiments described, unless under the instruction of an experienced and capable instructor. This is in order to avoid any complications which the neophyte would, with his or her lack of understanding of the deeper phases of the science, be at a loss to cope with.

SIMPLE HYPNOTIC EXPERIMENTS

AMONG the experiments that always cause hilarity when presented at social gatherings as an impromptu entertainment, and do not require much practice, we list the following:

1. Causing a spectator to lose the power of opening his eyes.
2. Drawing a spectator backward by seeming magnetic power.
3. Spectator cannot unclasp the hands.
4. Causing automatic movement.



Hands clasped in front of him with the arms rigid and the muscles tense, the subject cannote release his hands even when dared to attempt it.

In this effect the subject's arm or leg is made so stiff that he cannot bend it. The hypnotist requests him to try.

5. Making a spectator's arm or leg to become stiff so he cannot bend it.

These effects do not depend upon any magnetic powers of the performer, but are rather the result of appropriate suggestions heeded by the spectators themselves.

This will be readily understood when it is explained that the brain of a human being cannot, under ordinary circumstances, concentrate on more than one idea or suggestion at one time. Thus it is that if a certain, fixed idea is strongly impressed on the consciousness, everything else is disregarded for the contemplation of this one idea.

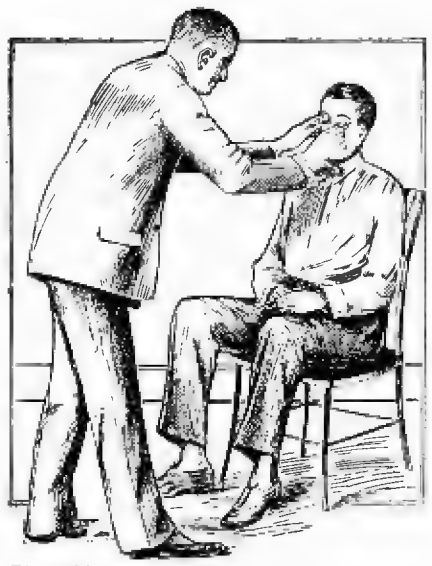
HOW TO PRODUCE THE EFFECTS

CAUSING a spectator to lose the power of opening his or her eyes.

First, select a subject who you are sure will cooperate with you fully and without antagonism. Cause the remainder of the spectators to be as quiet as possible. Seat the subject in an ordinary chair, and instruct him to relax completely. Both feet should be on the floor and the hands crossed in the lap in a relaxed and comfortable position.

State to your subject in a clear voice that his eyes are becoming tired and drowsy, that they are heavy and sleepy, that the eyelids are slowly closing. *Keep a running fire of suggestions along this line, never allowing your subject a chance to think of anything but what you are suggesting.* It is not necessary to make passes or to stare at the subject as if you would hypnotize him.

After a few moments of this, you will



The subject of this series of simple hypnotic experiments will find his eyes practically glued fast and it is impossible to open them until commanded to do so.

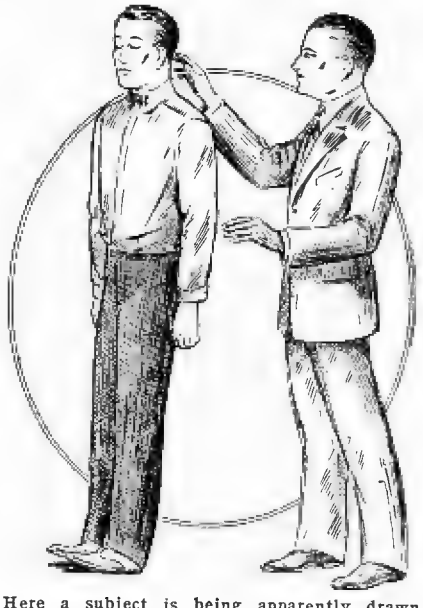
notice that the eyes of the subject have taken on a drowsy look. Then is the time to make a positive statement that the eyes are closing tight, fast shut. When this is accomplished, massage the eyelids with the thumbs several times, repeating over and over: *Your eyes are glued fast shut, and no matter how hard you try, you will find it impossible to open them.* The subject will immediately commence making ludicrous faces in an endeavor to open the eyes, but they remain tight closed, nevertheless, due to the suggestions that they shall do so. Allow this comedy to run for several moments, then snap the fingers near the subject, at the same time announcing in a clear voice, *Awake!* when the subject will suddenly open the eyes and a foolish, half surprised look will spread over his face.

It is interesting to note that the subject is *not* deeply hypnotized, but is just as awake as others in the room, although he has his mind concentrated on one single idea. It is the snapping of the fingers that breaks this train of thought and releases the subject from the impression that it is impossible to open the eyes.

DRAWING A SUBJECT BACKWARD

THIS effect is merely a repetition of the foregoing effect, the only difference being that the subject is impressed with the

(*Continued on page 660*)



Here a subject is being apparently drawn backward. Suggestion causes him to lean so far back that he finally topples over into the arms of the hypnotist.

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Science Probes Spiders' Secrets

Engineers Will Accomplish Wonders When Science Reveals to Them the Spider's Secret

By UTHAI VINCENT WILCOX

SCIENCE has been discovering some new facts about the spider. Whether or not this creature ever reached our earth from some other world, as some may believe, scientists are agreed that the spider is supreme in cunning, ruthless ferocity, inventiveness and courage.

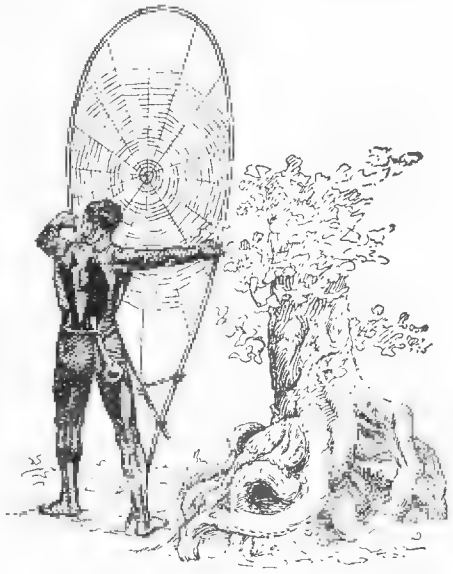
H. G. Wells once said that if man ever lost his mastery of this planet, the next race to dominate it would be the spiders!

Mr. Wells is hardly a scientist, yet Dr. E. W. Gudger, of the American Museum of Natural History, who for years has been studying the spiders, now announces the results of his varied observations, which would make of Mr. Wells a prophet. Experiments with spiders and careful watching of various kinds of spiders show an intelligence that leaves mankind amazed. It is doubtful if the average human being could begin to compete with the spider for engineering skill and inventive ability.

So important is the study of the spider that the United States Department of the Interior has been making an investigation of the spiders' webs. They found that a silken thread, spun by a spider, when photographed through a microscope that enlarged it some two thousand times, appeared to be but the size of an ordinary horsehair.

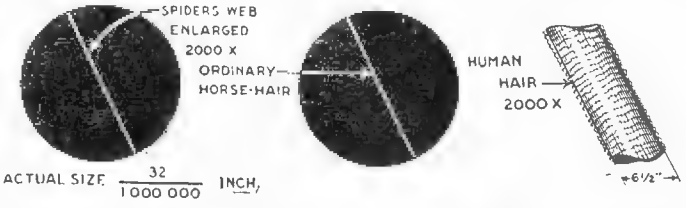
THE AMAZING STRENGTH OF SPIDERS' SILK

ON the other hand, a human hair, magnified on the same scale, would be six and a half inches thick. This is comparative, as well, of the relative strength of the two. The spider, with such an apparently fragile and transparent wisp of line, is able to bind animals several thousand times larger than that of any cord or rope that man knows how to make.



In Fiji, Trobriand and New Guiana, the natives use spiderwebs as fishing nets. On the latter island a native erects a stick, as indicated in the illustration above, and puts this where spiders are thickest. They weave the net right in place.

itself. The Interior Department is now experimenting with the spider silk, which is thirty-two millionths of an inch in diameter, yet incomparably greater in strength than



The spider's web is often as thin as thirty-two millionths of an inch in diameter. This means that if it were enlarged two thousand times, it would be as big as an ordinary horse hair. A human hair enlarged the same number of times is 6½ inches in diameter.

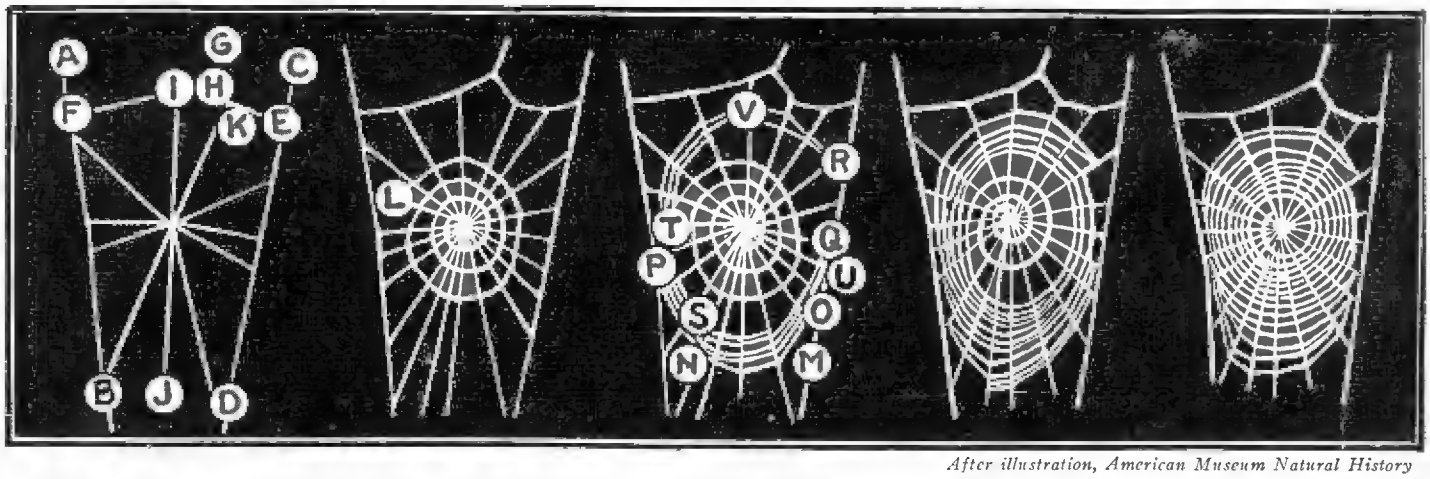
This diagram indicates the comparative size of the spider's web enlarged two thousand times with that of a horse hair and the human hair. The comparison is relative in strength also. A spider can, by its thin thread, bind animals several thousand times heavier than itself.

small frogs and snakes, lizards, and even bats. He found some of the results hard to believe, and, as a true scientist, waited a long time before announcing the results of his own conclusions. He tested some spiders by taking a dozen tadpoles and three tree-frogs.

Taking a jar with the tadpoles swimming in the water and a bit of a tree branch to keep the spider and the frogs out of the wet, he saw that the spider soon ate nine of the tadpoles, and then made a meal of one of the little frogs. From this he observed spiders about ponds and small bodies of water. It seemed true that tadpoles and small frogs are favorite dishes of hungry spiders. When the spider wants something to eat, he goes fishing. Even minnows have been known to vanish from an aquarium if a large spider is about.

But spiders, Dr. Gudger found, will even attack snakes. At Batavia, New York, a small ringed snake, nine inches long, was found trapped by a spider in a cellar. The spider, its body hardly bigger than a good-sized pea, had spun a web in the form of an inverted cone, from the tip of which hung a silken cable of about the thickness of ordinary sewing silk. By this cable the snake was found suspended, still alive, its mouth muzzled with multiple strands of web, and its tail tied by means of more silken cord.

Dr. Gudger also tells of a mouse that was snared by a spider. Apparently the snaring was accomplished at the start by winding silken threads around the tail of the rodent, perhaps while it was asleep. Anyway, the mouse was securely tied, and the spider, its web located beneath the table,



After illustration, American Museum Natural History

Left to Right: 1. The spider started from a branch above A and dropped to another branch below B, spinning a thread and fastening it. She then climbed on this thread to the upper branch, crossed over to a point above C, and dropped to a point below D, making a strand as before. Then, going to E, she fastened one end of a strand and, spinning it behind her, went across by way of the upper branch to F. She then went to the upper branch and dropped to this E-F strand, fastening the new line at point H. This pulled E-F up slightly. The next strand which she put in was from point I to a point on the lower branch below J; pulling this line made another angle in the cross strand E-F, as did the following line from K to B. These last two strands were fastened near their center by a bit of silk, and the remaining radii were put in by moving about on the foundation of the web. 2. The next step in the operation was the laying down of the primary spiral, which is shown in this plate and which ended at L. All of these threads consist of smooth, tough silk which is not sticky. From this point on, the spider uses the sticky threads which constitute the real snare. 3. The details of putting in the first of the sticky threads vary greatly. The spider started at M and its course may be followed by the letters to V, from V she continued in a regular spiral until the primary spiral of smooth silk was reached. She then cut away the outer portion of the primary spiral so that she might have more room for the snare. 4. The process of cutting away the primary spiral and putting in the sticky spiral is shown about half finished on this plate. 5. This plate shows the complete web with nearly all of the primary spiral removed.

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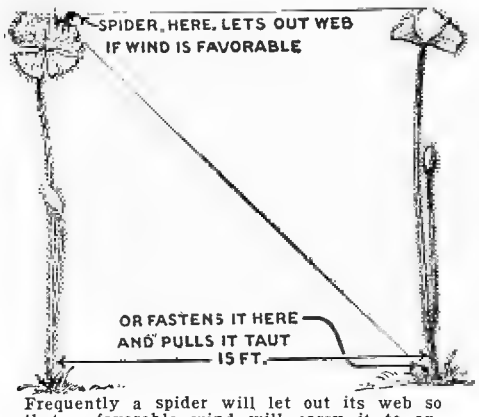


Frequently a spider will let out its web so that a favorable wind will carry it to another twig, branch or flower some distance away and will then proceed to weave its web or a spider may fasten the web to one plant, drag it along the ground, climb up another branch and pull it taut.

showed its engineering skill which led to the prophecy of H. G. Wells. By a loop, the mouse, despite its struggles, was hoisted off the floor into the air and hung there wholly helpless.

USING A SPIDER WEB FOR FISHING

IT is this fine, colorless rope which, coupled by skilled engineering ability, makes the spider's work so successful. Even man takes advantage of the spider's effort and uses the web. It is this fact that caused the scientists of the Department of the Interior to begin their investigations.

It is in New Guinea where the Papuans use spiders' webs for fishnets. The spider which is found there is a forest species and spins giant webs six and seven feet in diameter and woven in large mesh for the catching of small birds, as our house spiders catch flies and moths.

The primitive Papuan goes to the forest where the spiders are thickest and sticks upright in the ground the stem of a long and pliant bamboo, the top end of which has been bent over and tied so as to form a large loop. This loop makes a convenient frame in which to build a web and the spider, dark brown, and about the size of a hazel nut, with hairy legs that spread about two inches, seeing the ideal place for a web, soon takes advantage of the loop left by the native.

The Papuan then takes the net which has been presented to him and, going to a nearby stream, catches himself some fish by scooping them up with his spider's net. The beauty of the net is that the water does not seem to hurt it, because the threads are coated with a gummy substance that is waterproof.

SPIDER AVIATORS

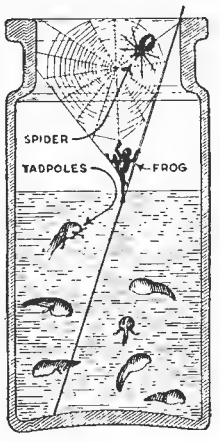
If man points to his mastery of the air, the spider can show that he has, for untold centuries, used aerial navigation. Many spiders are skilled aeronauts. Almost any warm day will show a spider in the act of taking a little joy ride through the air. Climbing to some elevated place, and letting loose a number of threads, the wind carries the spider for a pleasant trip.

The spider, Dr. Gudger observed, is able to descend at a convenient time by reducing the sail-spread, so to speak, and taking in some of the threads. Then slowly settling a silken line is thrown out as an anchor. These spider ships of the air are sometimes found at great heights. Even ships at sea have found them hundreds of miles from land.

It is this quality of adaptability to the air, to the water, to the needs of its appetite that gives the spider the respect, if also the fear, of mankind in general. Dr. Gudger observed a spider making a web. He said that a spider perched on a twig fifteen feet above the ground and wishing to throw a line to another twig twelve feet away, will either take note of the direction of the wind and use it, or will lower itself to the ground, running across to the desired spot, fasten the thread to it and then pull in the slack until the first line is taut. After that it is a simple matter of casting other lines at right angles and parallel, then dropping down or climbing up and pulling in the slack, a web is spun that will catch the needed food.

The spider lives in a world of an absolute matriarchy. The female is the fighter, the bread winner, and the autocratic monarch. The male is an undersized, meek little creature, who is likely to be eaten.

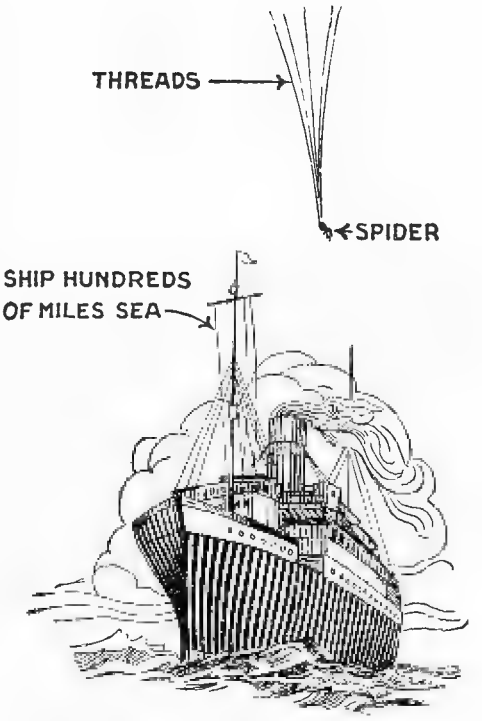
The lovemaking of spiders is a strange procedure unlike that found in any other world of nature. Matches are usually made at a kind of marriage fair in the light of the moon. The magic of the white sorceress seems to reach down at least that far in the scale of animal life, for when the moon's rays are on the forest paths or the rocky



In an experiment a spider was placed in a glass jar. Not only did she catch and eat a frog also in that jar, but fished for, caught and ate tadpoles.

slopes the spiders give themselves up to lovemaking.

Light seems to produce in spiders a strange ecstacy and they give expression to it by peculiar movements which some have called their love-dance. This is a solitary affair, but it serves as a means of introduction, for in moving about, one individual is almost



Ships hundreds of miles at sea have found spiders as aviators. The spider lets out a number of silken threads and is carried by them on a favorable breeze. Extra threads enable him to ascend. Taking in some of them helps the spider to descend.

certain to touch another. When this happens between males, they may stroke each other and pass on. But when a male and female meet, they perform the gesture in a dignified, meditative way, as if sizing each other up for further acquaintance. Either may decline this, in which case they go their separate ways. If mutually attracted, they stroll off together.

SPIDER LOVE MAKING

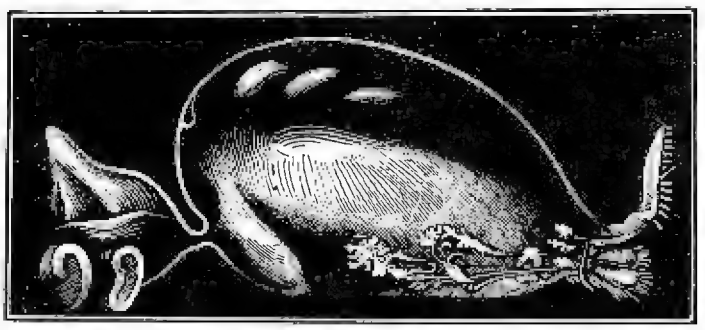
ALL this is equivalent to an engagement, and it may be either short or long. It may end in marriage, or a break-up. While it lasts, the couple devote their whole time to each other. They stand together for indefinite periods, stroll together, turn aside for no apparent reason, and loiter aimlessly, for all the world like country lovers in Maytime.

They quarrel and make up again. But mostly they seem to reflect upon the seriousness of matrimony. The fact of the matter is that he cannot be blamed for this, for the lady who is so nice to him as a sweetheart usually makes a meal of him as a wife; and she cannot be blamed, for she is not only choosing a husband but a dinner.

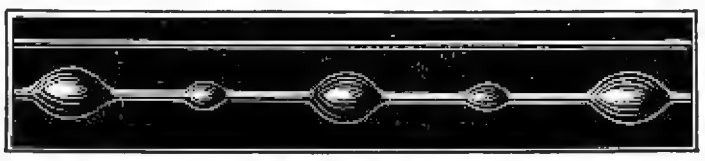
Insect observers have discovered that human society is not alone in being afflicted with the masher. The insects have him, too. The human specimen may even be a reversion to insect type, in which case it is more exact to call him an insect than a shrimp, a lizard or a cake-eater.

Fabre tells of one such male vamp among the spiders. These insects are formal and ceremonious in their courtship and this specimen wandered abroad in the moonlight after the manner of his kind, observing all the niceties of the ladies he met. But it was noticed that he had a frivolous way with him, and whether this was the reason or not, he wasn't well liked. He was turned down by one female spider after another. None seemed to

(*Continued on page* 668)



The diagram above shows a sectional view of the abdomen of a spider and indicates the spinnerets and the glands communicating therewith.



The upper view is a magnified smooth glossy thread; the lower, a thread with viscid globules.

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Inventors Ease

Products of Inventors' Minds and Engineers' Skill

By RHYS G.

THIS bachelor writer was once observing his little niece, June, as she romped about the house, when he suddenly made the discovery, amazing to him as a bachelor, that she was wearing a little undergarment of rubber, designed by some thoughtful inventor, to promote comfort and cleanliness for the baby that wears diapers. That's when the idea for this article on inventions for comfort and health of the baby was conceived. Further investigation revealed that there is now on the market a soft, comfortable, side-pinning diaper that gets away from the time-honored three-cornered dered. This is a clever product of the inventor—a knitted, elastic fabric that easily is adjusted to every movement of the child's body, thus method and that is easily laun- promoting cleanliness.

This new diaper may be put on while the baby is standing or while the infant is reclining, an added convenience for those who travel. They are quickly pinned at the side. The article is not here illustrated.

The above photograph shows one of the new folding bathtubs for babies. It will be observed that there is a tray in front for holding the sponge, soap, talcum powder, and also a bar for the towel. The tub itself is of rubberized canvas, with a top that can be folded over the tub and which then presents a soft surface on which to rest the baby while drying. The entire device can be folded up and put away.

This photograph shows the baby being placed on the top, which has been swung in place over the portable bathtub

NEW HIGH CHAIR

THERE is a new type of high chair, with an extraordinarily wide and heavy base to promote safety. This has an adjustable rest for the tiny tot's feet and legs, has a padded seat and a low back. This low back is intended to eliminate danger of baby bumping the head. The chair has a cross strap to help hold the child and has a tray across the arms for food or for toys. Under the seat are several compartments, giving ample space for keeping toys, blankets and other baby needs.

On the left we see a new type of chair for the youngster. This has a low back, so that the head cannot accidentally be struck against it, a toy or food tray and adjustable foot-rest and a spacious compartment for the storing of kiddie clothes or toys. Notice in particular the very wide base on this chair. It has been so designed to promote safety.

A DESIRABLE CRIB

A CRIB was recently introduced which has a cover that may be slid end-wise along the top to be used to hold baby while being dried after a bath. The top is of canvas, over a wooden frame, and there is a drawer for infant's odds and ends under the crib. A new folding tub of canvas includes a drying and dressing tray that may be placed over the tub. This light and easily carried tub may be placed in a large size one or it may be used elsewhere. Water is

Above: A form of harness for the child designed to hold the infant safely on a crib or a bed, and yet so constructed as to permit of freedom of movement in all directions. With it the child cannot roll out of any bed.

At the left we see an improved style of bottle holder for the youngster which will hold the bottle in place even if the child pushes it away. It can be attached to the crib, carriage, or chair.

(Name of manufacturers

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Mothers' Cares

Lighten Burden. Baby's Life Made More Comfortable

THACKWELL

drained from the bottom. It includes facilities for holding towels and soap and baby clothes. Made to be folded into compact space when not in use, a new crib has been invented that can be completely enclosed so that flies or mosquitoes cannot pass through the screened sides or top. This can be opened at sides or top, too, on occasions when baby is receiving company. Being on rubber-tired wheels, it is easy to move and quiet. This appears in folded and open form. The mattress can also be raised or lowered.

MILK BOTTLE HOLDER

A LONG, flexible arm of metal to hold a milk bottle securely, even though baby tries to push it away, has been invented to promote safety. This may be clamped to a chair, crib, buggy or almost any other place, and it bends easily to the touch of the baby, but it holds the nursing bottle tightly clamped so that a mother or nurse need not constantly be on the alert when the infant is feeding.

There is a new and cleverly designed harness to keep baby from falling out of a crib, davenport, Pullman berth, steamer berth, or other place where the infant might fidget around.

MILK BOTTLE—KEEP WARM

A KIT containing several feeding bottles that can be filled and kept at constant temperature in it for a long period has been produced so that mothers will not need to worry about feeding a baby on a long journey.

There is a safety walker with a swinging seat that teaches the child how to walk and which has a handle so it can be pulled by an adult.

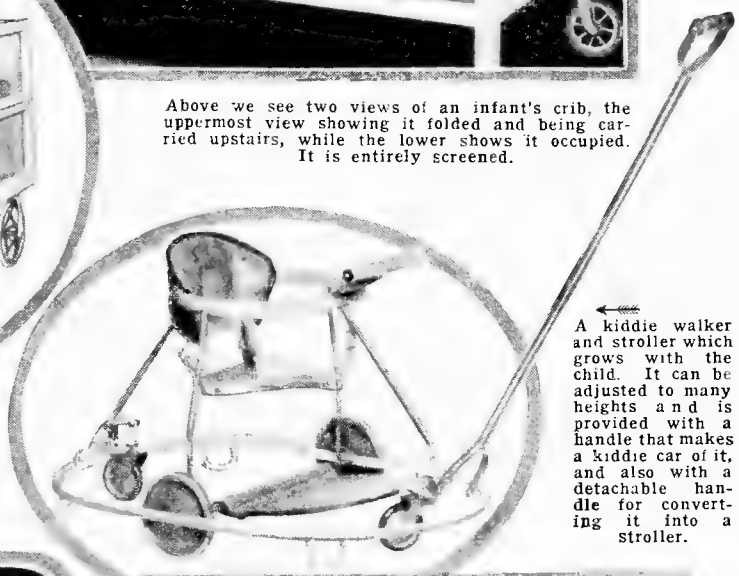
Several new types of cribs for use by baby in motoring with the family have been introduced. Some can be folded away when not occupied.

An attachment for the family scale so that mother can weigh baby on it has been marketed.

(*Continued on page* 663)

Above we see two views of an infant's crib, the uppermost view showing it folded and being carried upstairs, while the lower shows it occupied. It is entirely screened.

This shows a view of the kiddie's crib with the mattress raised. It also indicates the construction of the entire device. Screening excludes mosquitoes and flies.



A kiddie walker and stroller which grows with the child. It can be adjusted to many heights and is provided with a handle that makes a kiddie car of it, and also with a detachable handle for converting it into a stroller.

This shows one of the methods employed to prevent a child from rolling out of bed. The harness holds the child securely enough to prevent any accidental injury, and yet loosely enough to allow for freedom of motion. Right, a new form of sterilizer for babies' bottles; this is made of aluminum.

supplied upon request.)

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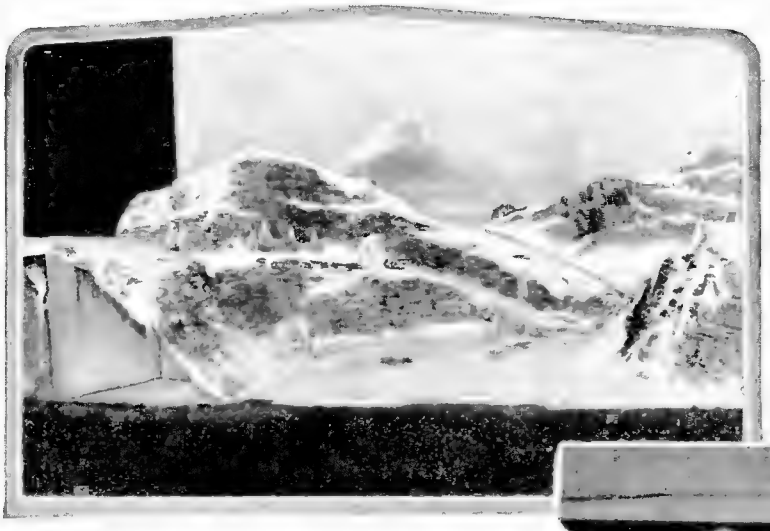
MOVIE

Miniature Sets and Dummy Used in Many Screen Effectively Fool

JOSEPH

THE express train rushing through the night suddenly plunges downward from an open drawbridge, hurling to destruction its unsuspecting passengers. You gasp, shudder, and possibly scream. When one considers that scenes of this nature are made with miniature sets, ofttimes only about one foot long, the effect upon the screen is nothing short of miraculous. In a New York exhibit, recently, many movie tricks were exposed. It takes a great deal of ingenuity and incomparable skill to construct a miniature scene, and have it actually look like the real thing when flashed upon the screen. Many of the dwarf objects are no longer than a man's hand and are constructed exactly to scale.

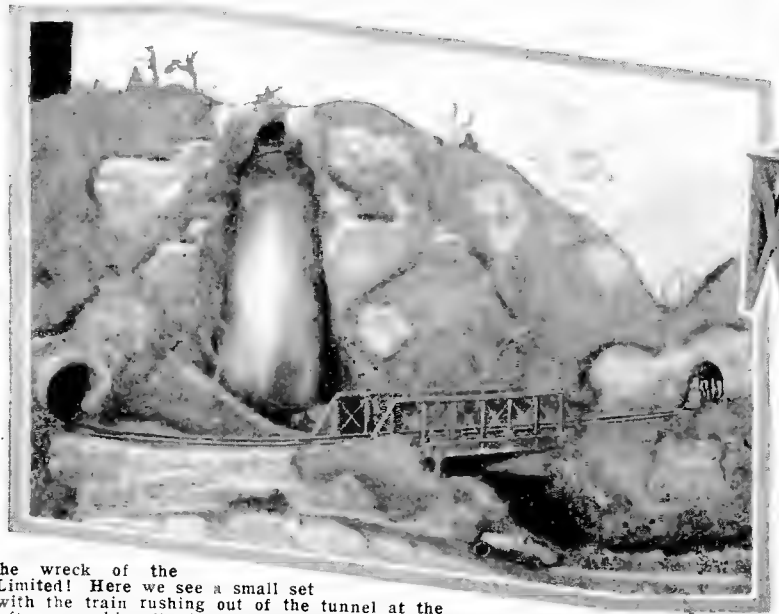


Above is an Alpine scene during a blizzard. Corn flakes are used for the snow and the huge drifts and glaciers are made of common table salt. The mountains are fashioned from papier maché thrown over cartons for support. The whole width of the set is only about one foot and yet, when seen on the screen, it looks like the real thing.

The young lady at the right is loaded down with a collection of objects from a railroad shop. All of the objects pictured are imitations. Even the telephone and bottles are dummies, despite their realistic appearance. These props are now being shown in an exhibition of movie tricks in New York City.

Above is a faithful miniature of one of Detroit's main thoroughfares. The structures in the foreground are mere doll houses, and the vehicles are small toys built to scale. Scenes taken in the studio were super-imposed upon this set.

The illustration at the right shows a holdup in broad daylight on Broadway. Strange to say, there were no casualties, because the pistol, despite its vicious appearance, is a "dud" and the sledge hammer is made of rubber weighing only a few ounces.



The wreck of the Limited! Here we see a small set with the train rushing out of the tunnel at the left, approaching the bridge over the rapids which are swollen with rain.

The good ship "Mary Ann" pitched and tossed in a tropic sea while there was mutiny aboard, and nefarious plotting going on in the captain's cabin, which is shown above. The small cabin can be rocked as roughly as need be. It is, however, built exactly to detail and fitted properly with midget furniture.

Unfortunately the cameraman arrived just a moment too soon to take the actual picture of the wreck which will occur in the picture at the left. The waterfall drops only twelve inches into the gorge. The hero is shown rushing to the scene in a racing car, in order to save the heroine from a watery grave. Movies of this dwarf set appear real when thrown upon the silver screen.

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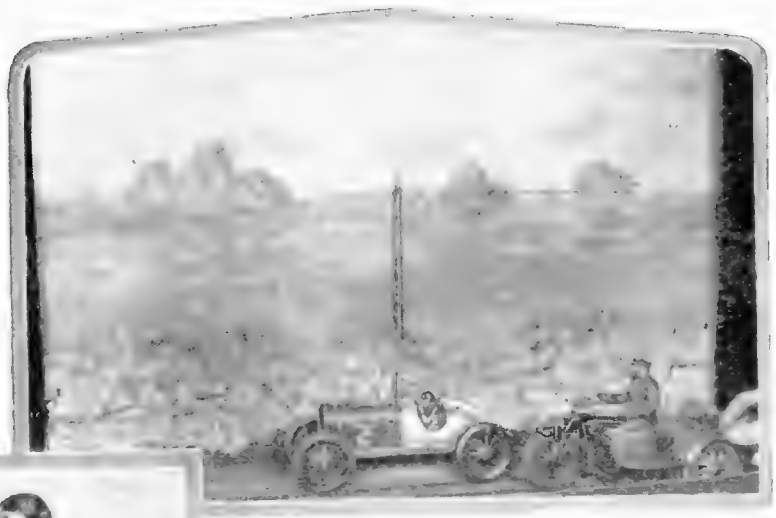
TRICKS

Props Portrayed Here Are Productions and the Audience

H. KRAUS

Pictures of the actors in suitable positions are taken with a dark backdrop and are then super-imposed upon the pictures of the miniature sets when this is necessary. Scenery moving past a stationary vehicle fools the audience into thinking that the car or train is traveling at a great rate of speed.

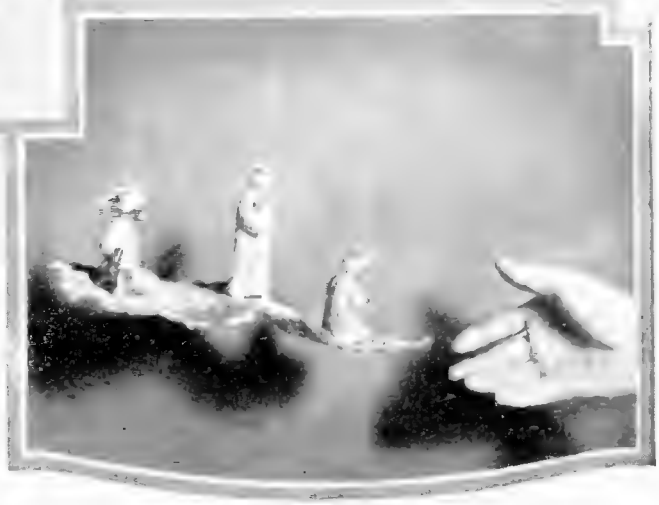
Dummy or fake props also play an important part in the filming of pictures. Some of them are illustrated on this page and we see guns, sledge hammers, swords, wrenches, and the like, which are apparently the real thing. Upon closer inspection, these props are found to be dummies and are usually made up of wood or rubber composition, light in weight.



The dashing hero races with a police motorcycle and gets a ticket for speeding. Above are shown all the props of the scene. Both motors are tiny replicas of the originals. The cars do not move at all, but the back drop rushes past, giving the effect of great speed. The size of the motorcycle may be judged by the man's hand, which appears at the extreme right corner of the photograph.

At the left the young lady carrying a huge gear and a railroad tie. The total weight of the burden is only 7½ lbs. The gear is made of a rubber composition, and the railroad tie is constructed of balsa wood, which is the lightest wood known. The large bolt is also made of a rubber composition which is light in weight.

Here we see an ocean liner foundering in the mid-Atlantic. The model ship is placed in a tank no bigger than a bathtub and is rocked by a small electric motor.



If you have seen "The Thief of Bagdad," you will probably remember the magic carpet. This aerial vehicle is shown above, and is no bigger than a man's hand. Wires are provided for suitable manipulation of the carpet and figures.

The above photograph shows G. Alex Limebaugh and two of his assistant technicians who are at work on a miniature city which they are building for a movie production, in the workshop set up at the exposition. He intends to show some of the tricks of the movie business which help to build suspense and make drama for the audience.

At the right is a movie prop workshop with a miniature city in the making. The size of the models are shown clearly in comparison with the figure of their constructor. On the extreme right, a section of the mountain set is seen. A small elevated road and an "L" train are visible in the foreground.

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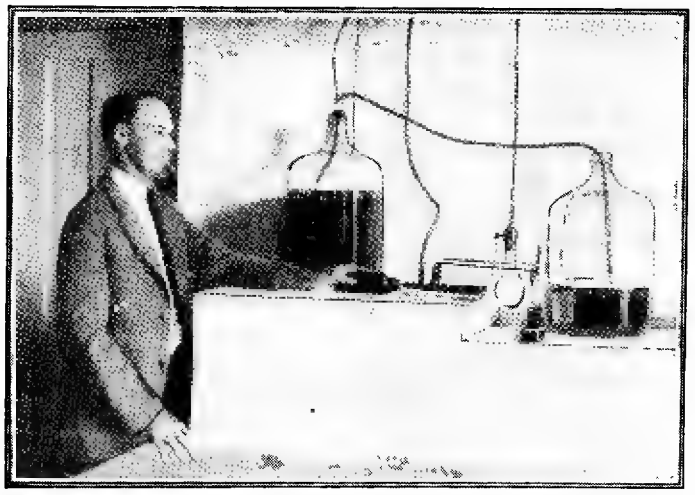


Dr. N. E. McIndoo, of the Bureau of Entomology, U. S. Department of Agriculture and the apparatus devised by him for ascertaining the odors which attract insects. Dr. McIndoo has named his apparatus an "insect olfactometer."

Is Civilized Man Losing His Sense of Smell?

By WALTER RALEIGH

"Fee, fie, fo, fum!
I smell the blood of an Englishman!"

EVERYONE is familiar with the terrifying chant of the terrifying giant in the nursery tale, but it has remained for a scientist to discover in it a vestige of truth.

Perhaps, in the days when this fabulous legend originated, people generally had much better noses than those we boast today, but, even if they did not, it is really quite plausible that a man-eating monster, such as the one described, might have been able to pick up his victim's trail in this very fashion.

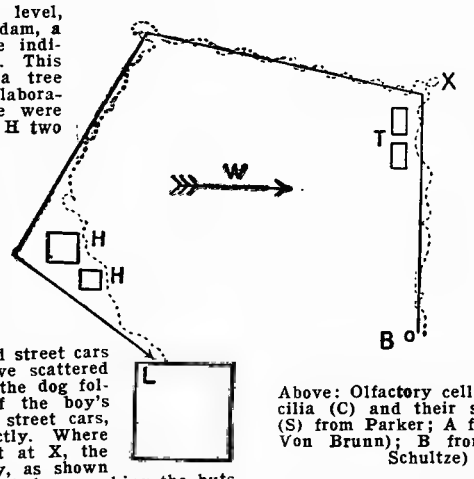


Diagram right: On a level, sandy place in Amsterdam, a boy followed the route indicated by the solid line. This route departed from a tree (B) and ended at a laboratory (L). At T there were two street cars and at H two huts used by construction workers. Upon completion of trip by boy, a police dog was led to the tree, where he was allowed to smell the boy's cap, and then followed the boy's trail as indicated by the dotted line. A strong wind was blowing in the direction indicated by the arrow (W). Between tree and street cars the wind seems to have scattered scented sand, because the dog followed to the right of the boy's track, whereas behind street cars, trail was followed exactly. Where the boy turned to left at X, the dog had some difficulty, as shown by his windings. Just before reaching the huts, the dog lost the trail, which is to be explained by the fact that many people were walking about, but he soon found it again. (After Buytendijk.)

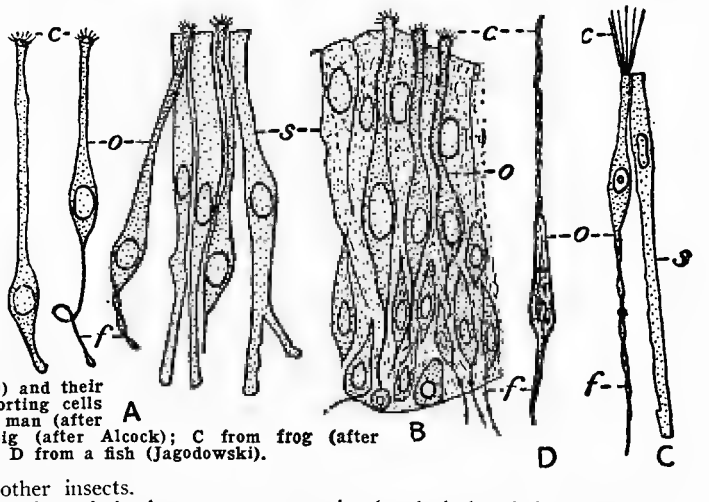
Conscious exercise of the nose being taboo, the human sense of smell may be deteriorating, in the opinion of Dr. N. E. McIndoo, of the United States Bureau of Entomology, who is interested in establishing a science of odors and rescuing from disrepute the "Cinderella of the senses."

He points out that primitive races have noses infinitely superior to those of civilized people, and that many savages trail their enemies and hunt their food by the sense of smell alone. Animals are even more alert to odors than savages. For ages the dog's nose has been considered a paragon among noses, but, says the scientist, when it comes to real hypersensitiveness, the insect walks away with first honors in any contest. His sense of smell is the *sine quâ non* of his existence.

A dog, for instance, can locate truffles, which are a species of fungus that grow underground, by sniffing at the earth close to where they grow. He can find his master by following his footsteps over surprising distances; but he cannot find a truffle at a hundred yards, or locate his master in the complete absence of a trail.

SMELLING FOOD MILES AWAY

DISTANCE, apparently, is no handicap at all to an insect, nor does he need a trail. Boll weevils, Dr. McIndoo has found, may be hatched miles from growing cotton, but they can locate it and head straight to it, led by some mysterious faint odor that man, walking through the very field, cannot detect at all. The same is true of moths, ants, bees and other insects.



Above: Olfactory cells (O) and their cilia (C) and their supporting cells (S) from Parker; A from man (after Von Brunn); B from pig (after Alcock); C from frog (after Schultze) and D from a fish (Jagodowski).

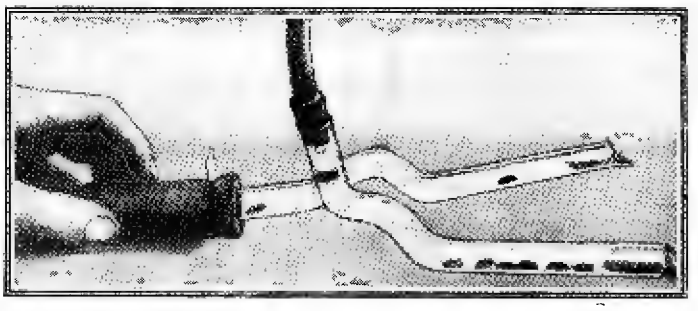
Returning to his discussion of the human family, Dr. McIndoo, in an interview, cited a number of literary references to the acuteness of the sense of smell in savages, which tend to prove that man, living apart from nature, loses some of his alertness to the world of odors.

"Ethiopians," he stated, "and North American Indians have a remarkably keen sense of smell which, in part, accounts for their wonderful ability to trail their enemies. An old history of the Antilles states that some of the Negroes there can distinguish the footsteps of a Frenchman from those of one of their own race, and we are told that the cannibals and snake-eating tribes of Queensland hunt, by smell, alone, a species of boa upon which they live. A white explorer, who witnessed such a hunt, put his nose to the ground and was unable to detect the odor which the tribesmen were following with ease.

"Certain Peruvian Indians are reported to be able to follow a trail by scent as reliably as a hound. Another writer describes experiments, repeatedly conducted, which proved that Negroes and Indians recognize persons in the dark by their odors."

The entomologist at this juncture, however, finds it encouraging to note, that the civilized nose can be educated and that, even in modern countries, certain persons exist who are monstrously clever at detecting and analyzing odors. Dr. McIndoo has made a special study of bees in the course of his entomological experiments, and, in addition to making some rather startling discoveries regarding the private life of this model insect, has trained himself in their ways to the extent of being able to distinguish different hives by their characteristic odors.

(*Continued on page* 642)



Section of Olfactometer, showing insects leaving container and traveling out into the two tubes connected with it. The odor being tested is in one of the legs of the Y tube, whereas the other is free of it. Insects are in a bottle connected with the olfactometer via the tube held in the hand. Oderiferous substance enters through the upright hose. Note greater number of insects in this leg.

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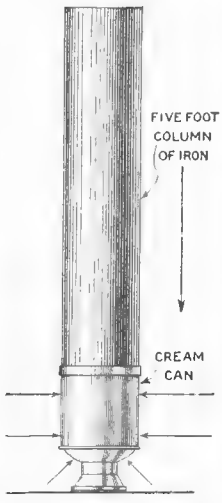
Danger—High Vacuum

By EMERY G. GREGORY

Faraday's vessel was made of thin tin, contained a small amount of water and was equipped with a stop-cock.



In the drawing above a cream can is shown standing on end with five feet of solid iron resting on the upturned base.

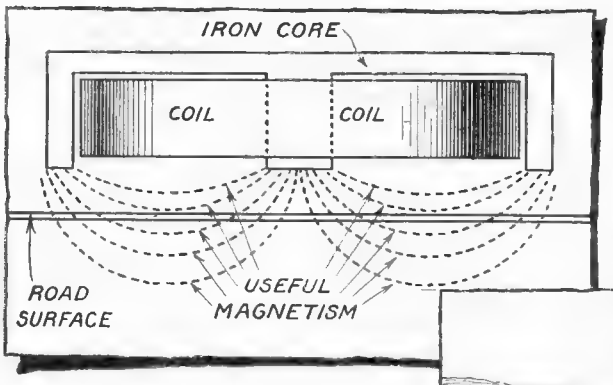
Below is an illustration showing the type of vessel used by Michael Faraday in carrying out his experiments with the vacuum.

Above, we have a photo showing how the cream can was completely disrupted, owing to the vacuum created within.

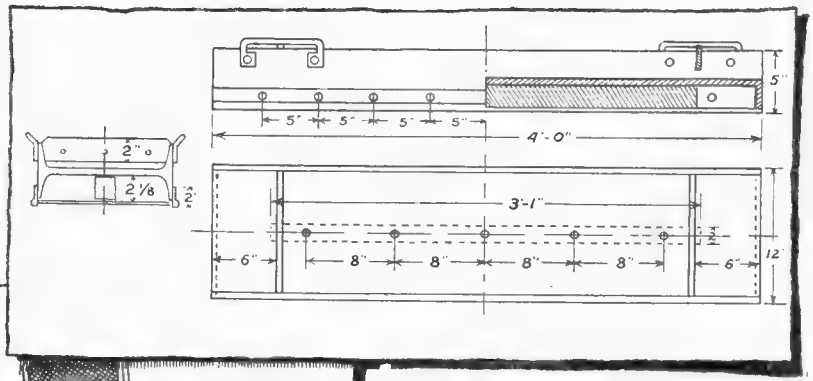
EACH day we walk in the presence of forces, not unknown, but at least unnoticed or unthought of until some accident or conversation or picture brings them to our minds. A new employee in a Wisconsin creamery was brought into contact with the full meaning of the mighty force represented in air pressure, when one morning, he began the washing of the empty cream cans. He had just washed out a can, then scalded the interior with live steam, after which he dropped the cover back into place. He started washing a second can. Turning around he found the first can in a state of

(*Continued on page* 659)

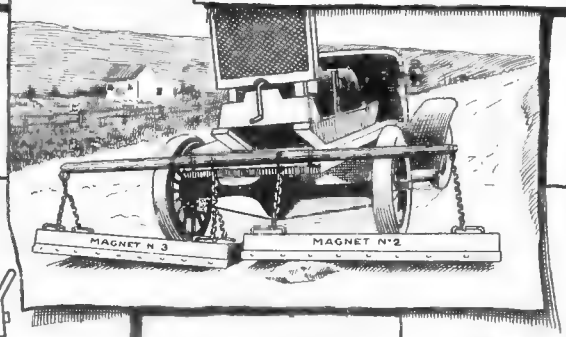
The Magnetic Nail Picker

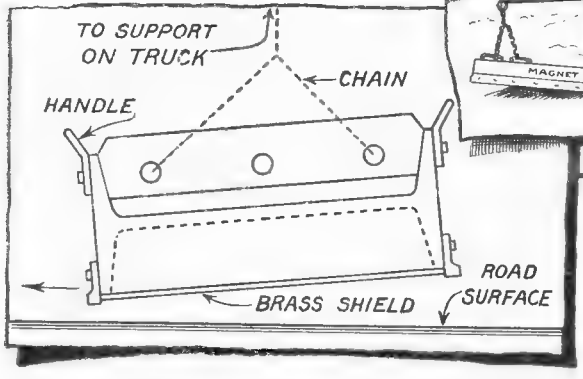


The magnet and the area of useful magnetism in the nail picker are shown above. Current for the magnet is derived from a Ford engine-driven 3 k. w. 110-Volt D. C., generator.



The magnets were designed in sections four feet long. The core of each magnet consists of a 12-inch I-beam, to the center of which is bolted a 2 x 2 inches square bar of iron. Below, we see the amount of iron and nails collected from various Washington highways.





The magnetic nail and iron picker is shown above in operation. The magnet winding consists of 315 turns of No. 7 double cotton covered square magnet wire. At the left is shown the method of supporting the magnets.

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Scientific

A Photographic Picturization

It is almost impossible to keep up with the rapid strides taken in the field of science. This is truly a scientific age.

Tourists arriving in Washington, D. C., find a huge portable swimming pool at their disposal. The pool is 40 ft. long, 10 ft. wide, and 4 ft. 9 inches deep. As may be seen in the above photo, it is constructed entirely of waterproof canvas supported by a steel framework. The pool is readily portable, and can be set up in two hours' time. Several ladders placed around the edge provide entrance and exit to and from the pool.

Illustrated below to the right is a new German toy which is propelled by means of a rocket, as was recently done in the case of racing cars. A tiny rocket exploding in the rear propels the automobile forward.

The above illustration shows Dr. Burt, who has invented a new device which may be termed a "Sunburnometer." The resistance of the skin to the sun is tested by this machine, and it is possible to ascertain just how long one may expose his skin to the sun's rays without injury. In making the test, a small patch of skin is exposed to the ultra-violet rays which emanate from the device.

The photograph at the right shows several more of the German rocket toys. Several airplanes and an automobile may be seen being driven by the explosion of small rockets placed in the rear of the toy. With the success of the Opel rocket automobile, the German children have discarded their old-fashioned toys in favor of the new ones, illustrated here.

The above photograph shows Anita Page, a screen star, having her voice analyzed. At the same time she is being photographed by a movie camera. These tests were made by the University of Southern California.

At the right may be seen the voice record. A permanent record of the voice is made upon a steel wire by means of an instrument known as the telegraphone which has been described in this magazine several times.

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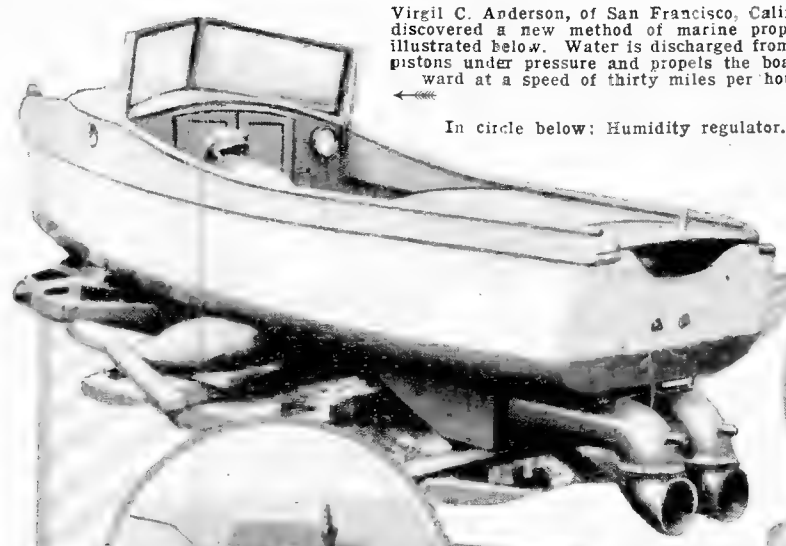
Progress

of Modern Scientific Advances

On these pages we can portray but a few of the advances made in many different scientific fields.

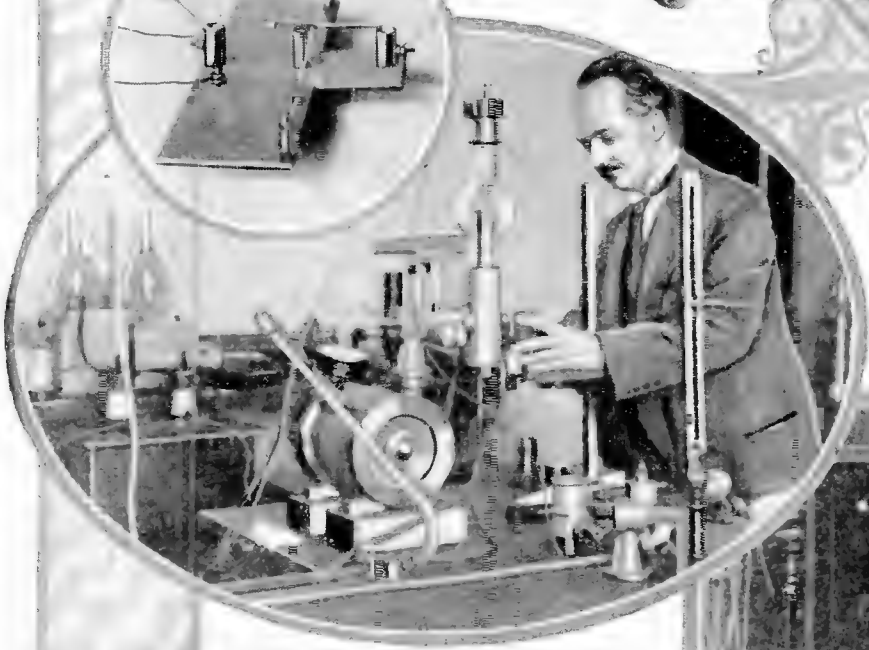
Virgil C. Anderson, of San Francisco, Calif., has discovered a new method of marine propulsion illustrated below. Water is discharged from twin pistons under pressure and propels the boat forward at a speed of thirty miles per hour.

In circle below: Humidity regulator.



Above is a new French invention known as a fish tail sculler.

An untrained person can operate the apparatus by simply swinging the tiller back and forth, as shown above.



In the laboratory of the Portland Cement Association in Chicago, a single human hair plays an important part. The slender filament regulates the humidity of the room in which tests on cement are made. The regulator is shown at the left in the small circle. When there is too much moisture in the room, the hair elongates, raising a bar shutting off the humidifier. When the air becomes dry the humid air is admitted.

Dr. F. Holweck, an X-ray expert is shown at the left operating his machine, which tells exactly how much energy in the form of X-rays is needed to kill a single germ. Some germs are harder to kill than others, and Dr. Holweck asserts that this is probably due to the fact that the X-rays have failed to strike a vital spot.

The above illustration shows a new device which cures colds by electricity in a few minutes. A high frequency current generates heat which penetrates the mucous membranes of the nose.

The illustration at the left shows a new apparatus for treating diseases by short radio waves. The human body is subjected to the high frequency radio waves which are projected from the apparatus on wavelengths between 80 centimeters and one meter.

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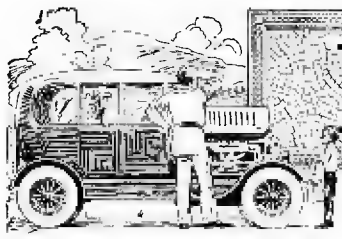
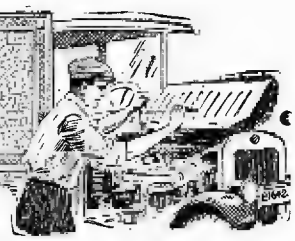


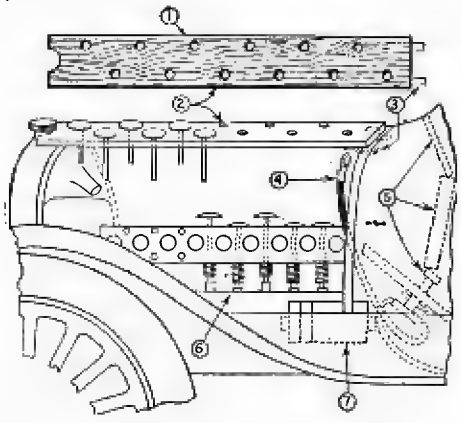
Motor Hints



Conducted by GEORGE A. LUERS

TO REDUCE LABOR AND TIME OF VALVE GRINDING

Valve grinding and adjustment is a requisite detail of engine care, and means to reduce the time and labor incident to this work are important to the owner who does this work himself.



Above—1, piece of wood; 2, valve holder; 3, metal clips; 4, terminal wire; 5, starting switch held down; 6, indicates view of the engine, and 7, starter motor.

In many of the new cars, the use of silichrome valves, which are very hard, makes the use of previous soft grinding compounds almost useless. Select a brand of valve grinding compound which is sold for use in grinding these hard surface valves.

To avoid the trouble of turning the starting crank, to raise and lower valves to their seats, while either grinding or adjusting, the starter can be used. Remove the starter terminal, wedge or tie down the starter switch and use the free end of the terminal wire to make contact with the starter terminal screw and thus quickly turn the engine. This will be understood by reference to the sketch.

A simple valve board, made as shown in the sketch, has proven of especial value in valve work. This is only a piece of wood, cut at one end to fit around the radiator cap. The other end has two small clips to engage the cowl. As many holes as the engine has valves, are drilled through the board. This permits the valves to be kept in correct order and is right at hand. These means permit of working directly over the engine, without frequent trips to the work bench or to the starting crank.

SPRING HEADREST FOR THE CREEPER

The creeper is an almost indispensable need for lubricating, adjusting and repairing the car. The usual type is more than uncomfortable and unless the user is accustomed to it, lame neck and shoulders follow its use.

One motorist has made and uses an improved type of creeper, which is shown in detail in the attached sketch.

A spring type of headrest is fitted, which feature effectively overcomes the lameness usually resulting from the roller board.

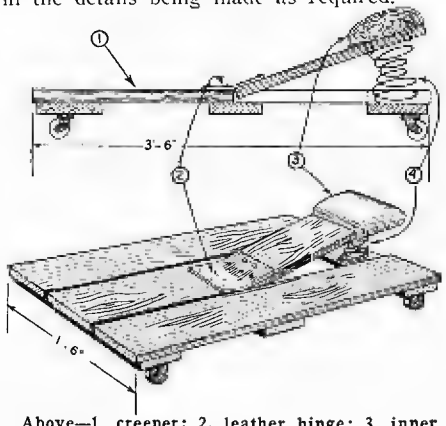
The spring headrest is made by cutting the center board of the creeper, hinging this with a piece of leather and fitting a cushion spring under one end. At the position of the head, a cushion is made of rubber, using cotton waste as a filler.

The creeper body is of the usual type, with three boards running lengthwise, cross stiffeners and four small furniture casters.

The main feature of the device is the spring headrest. This should be provided with a sufficiently heavy spring to lift the head. If one spring is not sufficient two can be used, or a heavier spring should be obtained. It is possible to modify any previously built creeper, for this headrest, even though it is of the metal type, slight changes in the details being made as required.

DO YOU KNOW—

the numerous nickel-plated parts of the car can be protected through the winter with one coat of quick-drying brushing lacquer. Polish the nickel, apply one coat of clear lacquer, and the nickel will stay bright. Use lacquer thinner to remove this in the spring and the nickel will be found none the worse for the winter's snows and rains.



Above—1, creeper; 2, leather hinge; 3, inner tube stuffed with cotton waste, and 4, cushion spring secured with staples.

WORN OR LOOSE BEARINGS OR PART CAUSING KNOCKS

There are two usual methods of readily determining a bearing knock or thump, tracing it to its source, or location in the engine of the car.

First—by accelerating the engine quickly, at which time a rattling and clashing noise will be heard if some part is defective.

Second—by starting the car with the emergency brake set, which causes the engine to pull against the heavy resistance and the knock will be most pronounced.

If a long metal rod, such as a long screw driver is held, one end against the ear and the other against alternate locations on the engine, the particular spot where the trouble exists will produce the loudest noise at the end of the rod next the ear.

Where the sound is loudest at the top of the engine, short-circuit the spark plug on that cylinder. Where the noise disappears, when the plug is shorted, the trouble lies in that particular cylinder.

The next thing to determine is whether the noise is of a worn piston or a worn and loose piston pin.

A worn piston pin cannot always be located through short-circuiting a spark plug but if an exhaust or intake valve is propped open, the knock of a worn piston pin will usually disappear, and this also indicates the cylinder in which the trouble exists.

A motor should always be run long enough to heat up, when making any tests for worn parts, as a cold motor is always noisy, and even the most experienced ear cannot detect sources of trouble in a cold motor.

A loose piston is most evident with a full advanced spark, while retarding the spark will lessen the noise of a loose piston. A second test for the loose piston, is to squirt oil into the intake manifold from an ordinary squirt can, this being done of course while the engine is running. Oil will stop the loose piston noise immediately, thus proving the cause of the noise.

The replacement of pistons or piston pins, is usual through the top of the engine after removal of the cylinder head. Be certain of the parts, however before installing them.

When a noise appears to come from the base of the engine, the owner must determine if it comes from the crankshaft bearings or the connecting rod bearings. If the engine is put on the pull test of working against the brakes, the screw driver or rod method will determine the location most accurately.

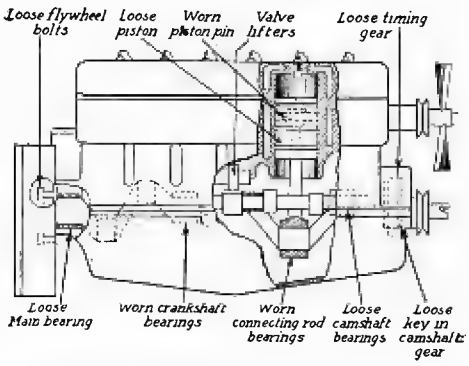
If however the crankcase lower cover is removed, the bearings can be individually inspected, and adjusted where necessary.

Worn and improper adjusted valve lifters and push rods, are noise producers, but are easily detected, being adjusted or replaced by new parts.

A loose flywheel is a noise that is very difficult at times to locate, this is due mainly to the fact that this noise is transmitted to all parts of the engine and gives the impression of being loose main bearings. Engaging high gear and putting the engine to pull against set emergency brakes, causes the noise of loose flywheel bolts to disappear. This same action with loose main bearings will increase the noise, thus pointing out the trouble.

Noise around the camshaft may be due to loose camshaft bearings, loose keys in the camshaft gear or a loose timing gear.

The test is to place a hacksaw blade or other spacer between the valve tappet and the valve stem. The pressure of the valve spring will usually cause a loose camshaft bearing to run quietier. This test should be made on several positions along the camshaft. If the noise persists, the timing gear cover should be removed and the keys in the timing gear and camshaft gear should be inspected.



The above illustration shows the worn or loose parts of an automobile which will cause knocks.

The more common trouble, is usually with the camshaft bearings. Several thousandths of an inch play in these will produce quite a loud and noticeable knock in the engine.

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PEAK LOAD

How Matt Boyle, old gas plant engineer, became a hero when the machinery failed at a crucial moment

By E. G. MARTIN

OLD Matt Boyle stepped out of the booster-house and stopped, patched coat over his arm and dinner-pail in his hand, for a final survey of the works of the Homestead Gas Company. He had done the same thing at 3:30 P.M. every day for the six years he had been booster-man—but this was different. Old Matt was through! this was his last look. No chance of *his* coming back to hang around the works after being fired! Damn the directors and their retirement rule! What right had they to kick out an able-bodied man, just because he was born sixty years ago, take away the only job he cared anything about or was likely to get?

Not that Matt Boyle needed the money so much. He'd always had the habit of saving a good slice of each week's pay. Matt had plenty saved up to loaf comfortably for the rest of his life if he wanted to; or he could raise chickens. All gas men, like all sailors, plan to retire sometime and raise chickens. No, it wasn't that. Only—well, Matt Boyle had gone to work for the Homestead Company when he was eighteen, a raw emigrant lad just over from Ireland. He'd been working there ever since, and since a gas-works operates three hundred and sixty-five days a year, Matt hadn't found many outside interests.

Nearly all the men had been Irish then, deep-chested, black-mustached men who worked twelve to sixteen hours a day in blazing heat and fought with each other like ramping stallions after their week's pay had been exchanged for rot-gut whiskey. Matt's faded eyes brightened as he remembered the time he fought Red Shaughnessy in the "Palace." Red had been head of the Gas-House "Tarriers," until Buck Boyle took him off his pedestal. They had called him "Buck" Boyle in those days, Buck Boyle water-gas maker and king-pin of the works. Men nowadays weren't what they used to be—Wops and Bohunks most of them, even Mexicans.

Buck Boyle had been water-gas maker until the new, automatic machines came in to replace the old, hand-operated sets. Then they had wanted men with more mechanical training. Since then, Boyle had fallen to boiler-firemen, yard-boss, and finally booster-man, that last refuge of the old-timer. Now he was out.

Before Boyle finished his inspection, Heck Barry found him. The plant foreman was obviously ill-at-ease.

"I was afraid you'd get away before I caught you." He paused awkwardly. "You know, Matt, I hate to lose you. Come down and visit us whenever you can, will you?"

But Matt was not to be pacified. "Loike Hell, Oi will!" he said.

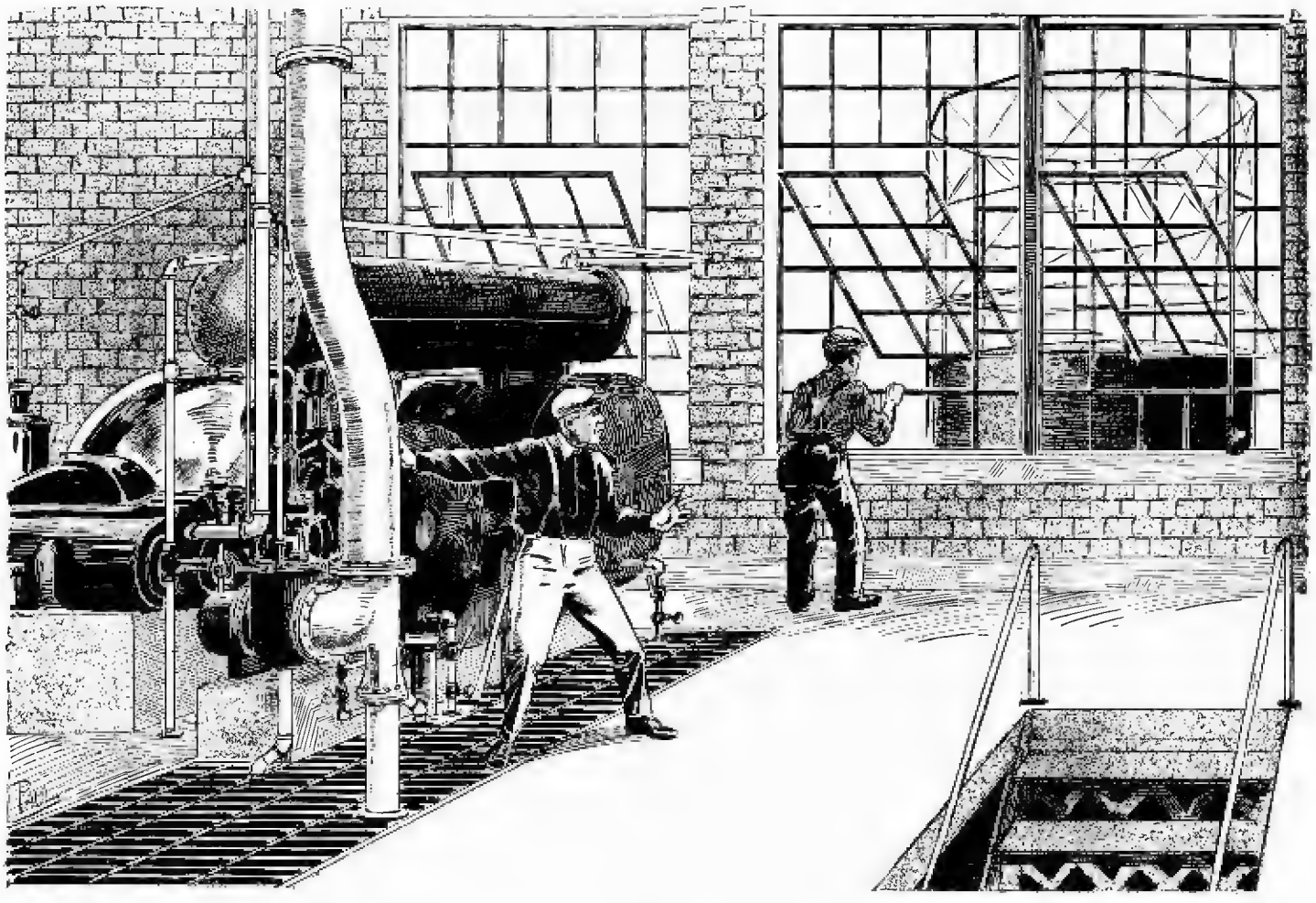
Barry fidgeted nervously as if he didn't know what to say next. A coughing burst of sound from across the yard saved him the trouble. Shattered glass tinkled on the ground and smoke gushed from every window and crevice of the water-gas house.

"Holy Peter'n Paul!" Barry gasped. "What's that crazy Wop done now?" He departed on the run for the water-gas house and Matt followed more leisurely, stopping to set down his dinner-pail and glance up at the holder.

Like all gas men, Matt had almost a superstitious awe of the holder. It was their real master. Managers, supers, and foremen could come and go, but the big tank was always calling to be filled. Built in telescoping sections like a folding drinking cup, it slid up and down between steel guides, rising high as the gas in storage grew during the night, sinking into the huge, circular tank of water as the supply was drawn upon to cook thousands of breakfasts and dinners. The customers were far away—nebulous abstractions to the workmen; but the holder was right before their eyes, an insatiable monster, always having to be fed, always ready to seize an opportunity to sink "in the mud."

"In the mud!" That was the supreme disgrace, the ultimate calamity. A boiler might burst, killing its fireman; condensers and purifiers might clog, stopping the endless

(*Continued on page 647*)



"After the next period of re-fueling, Matt took time to glance out at the holder. Jerusalem, my happy home! It was low! They were fairly on the peak now, it was 5:30 and half an hour to go before the maximum was reached and the demand began to drop off; an hour or more before they would be safe. Number Ten groaned and erupted smoke and steam from every crevice. . . . Those leaks worried Matt, not because of the leaks, but . . ."

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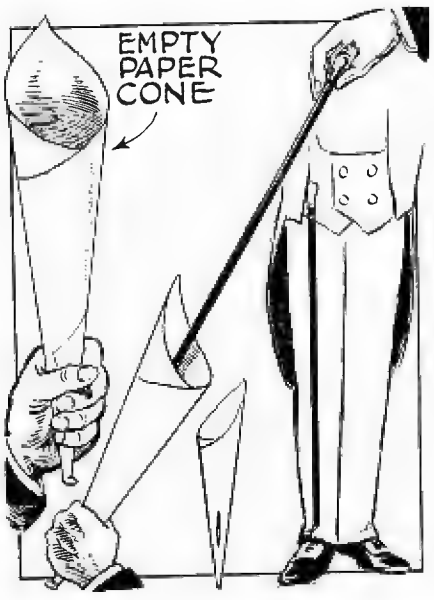
MAGIC

By "DUNNINGER"

NO. 68 OF A SERIES

THE ENCHANTED CANE

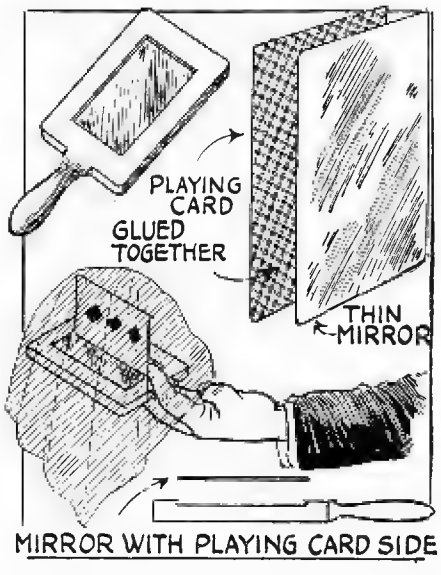
THIS experiment differs materially from the usual routine of magical mysteries. It requires no special paraphernalia. In effect the performer displays a large sheet of paper showing both sides thereof. He rolls this into a cone, then, holding this cone in front of him, he puts his hand down into the open mouth and extracts a full length cane which he taps to indicate its solidity and then passes out among the audience for free examination. In order to perform the effect, a straight cane with a knob at the upper end thereof is provided. This is previously concealed within a special pocket sewed within the performer's trouser leg. Thus suspended, the performer finds no difficulty in walking back and forth and need not arouse suspicion. During the act of rolling up the paper cone, he puts his hand inside and tears a slit through the paper through which the cane can be easily grasped and removed.



After rolling up a piece of paper into the form of a cone, the performer puts his hand into it and withdraws a regular walking cane. As will be observed, this has been previously concealed in the leg of his trousers.

THE DEMON REFLECTION

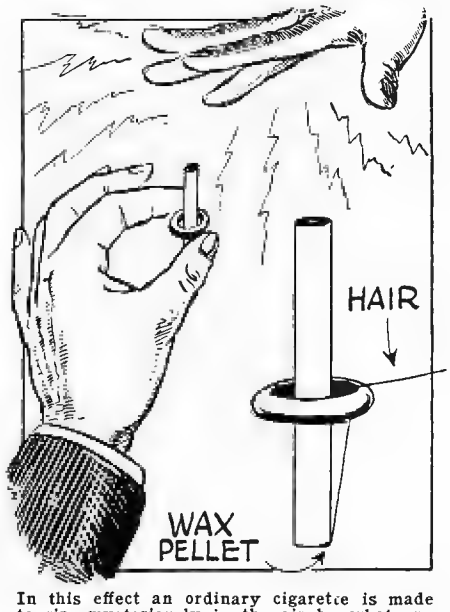
A SMALL hand mirror is passed for examination, and when found to be intact is returned to the wizard. A pack of playing cards is then fanned out and a spectator selects one and names its suit aloud. Let us assume that the trey of hearts has been chosen. A pocket handkerchief is next borrowed and the selected card is placed face upward on a small hand mirror. The mirror is then given to someone to hold. The affair is now covered with a handkerchief, and when the kerchief is removed the card is found to have mysteriously vanished. On looking through the deck, it is there again located. The explanation: two cards identical in suit are used. One of these is forced. It is left in the deck while apparently being removed, and the duplicate or prepared card is removed from the bottom of the pack. This duplicate is an ordinary card glued to a small mirror. When placed on the mirror frame it is turned by the magician under cover of the handkerchief.



A forced card is placed on the face of a mirror covered with a handkerchief and on removing the handkerchief, the card has disappeared!

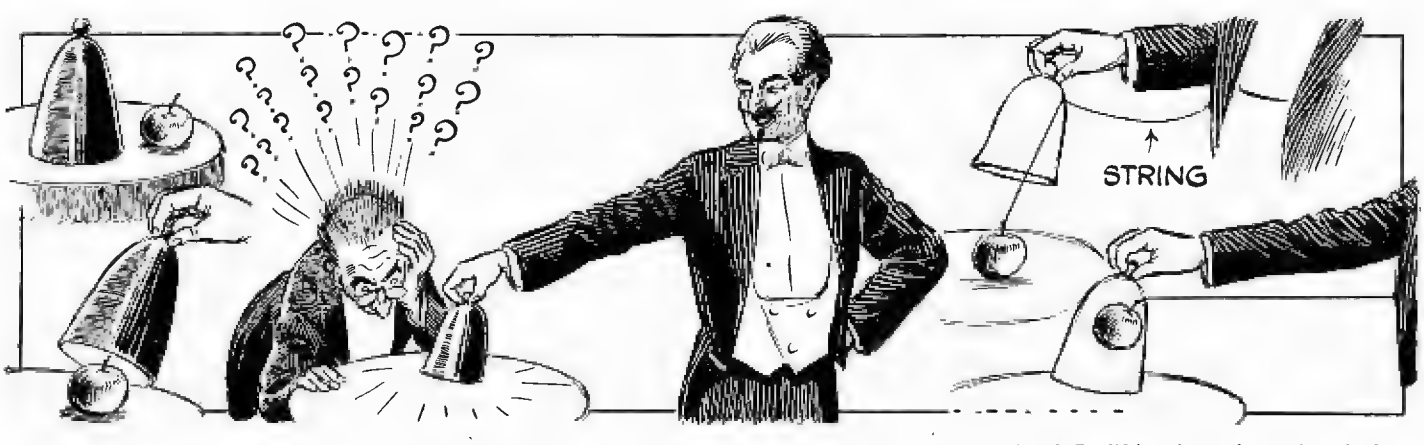
CIGARETTES AND FINGER RING TRICK

THIS is an excellent pocket trick and can be presented as a spiritual effect. The magician borrows a finger ring, and in keeping with his policy of borrowing, he also borrows a cigarette. He pushes this cigarette through the finger ring, which is held lightly between the thumb and forefinger. Now, raising his hand and making mysterious passes, the cigarette remains suspended in the middle of the ring, and at command rises or falls! Having produced the effect several times, the magician returns both borrowed articles intact. The explanation is rather simple. An ordinary finger ring is used and the cigarette is attached to a thread with a pellet of wax. By moving the hand further away from the body, the cigarette is made to rise. When brought closer, the cigarette falls. This is due to the fact that the hair is attached to the vest button.



In this effect an ordinary cigarette is made to rise mysteriously in the air by what one can assume to be a mesmeric force. Actually a hair and a pellet of wax produce the effect.

A NEW CYLINDER TRICK



In this effect the magician makes an apple disappear and reappear as often as he desires. The only requisite is a cylinder larger than the object to be vanished and, of course, the magician's indispensable black thread. It will be observed that the thread passes through the side of the canister and is attached to the article to be vanished. By lifting the canister when the hand is held close to the body, the object will remain in sight. By stretching the arm out to full length, the object, of course, remains within the confines of the metal covering. Thus the effect can be repeated as often as desired.

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Can You Answer These Questions?

(Form your own answer before turning to page indicated)

1. If you were awarded the masonry contract to place all the brick and stonework on the various floors of a thirty-story skyscraper, how would you arrange to carry on the work as the building structure progressed? (See page 586.)
2. Did you know that television has found a new application in the realm of music; that in fact it is to be used this season to aid in the conducting of two orchestras simultaneously? (See page 587.)
3. What were the cylinders on Lindbergh's famous air-cooled engine made of, steel, iron or aluminum? How are the cylinder heads on this particular air-cooled motor secured to the cylinder sleeve? (See page 590.)
4. What is probably the cheapest and easiest way in which to insulate your house so as to save a considerable amount of coal this winter? (See page 592.)
5. If you simply sit in a chair and close your eyes, and then a person tells you that you cannot open them, do you think you could or could not open your eyes? (See page 593.)
6. How thick is the strand of a spider's web? Do spiders ever sail to sea by means of their own web threads? Can a spider lift objects many times its own weight? (See page 594.)
7. How are movie scenes taken showing a ship's cabin with the ship rolling heavily? How are many different movie "street scenes" taken? How was the flying carpet in "The Thief of Bagdad" photographed? (See page 598.)
8. Does a dog have a greater sense of smell than a man? How does the boll weevil locate cotton when it is hatched miles away from the growing cotton plant? (See page 600.)
9. In producing "movies" with an amateur camera, how would you show a person diving from a springboard, and then ascending backwards up to the board again? (See page 609.)
10. What is the simplest test you know of to determine genuine butter from renovated butter? How can you easily tell whether a certain fruit jam has been colored with a coal tar dye? (See page 611.)
11. If you have ever done any wood finishing, and most of us have at some time or other, can you explain how to apply the well-known French polish? (See page 614.)
12. If the image in a television receiver is observed to be upside down, how can you reverse it? How can you magnify the size of the television image? (See page 618.)

Jupiter in a Stereoscope

By DONALD H. MENZEL, Ph.D., Lick Observatory

WHY the brain should synthesize the apparently "flat" picture seen by each eye into a view possessing the depth of three dimensions is a mystery not yet solved by the physiologist. The well-known stereoscope takes advantage of the phenomenon, presenting two views, differing in perspective just the amount by which the eyes are separated. If the two scenes are exactly alike, the illusion of "depth" is entirely lacking.

When so distant objects as the planets are studied stereoscopically, slightly differing views must be obtained. Astronomer William H. Wright, of Lick Observatory, has solved the difficulty in an extremely interesting though simple manner for Jupiter, allowing the natural rotation of the planet to change its aspect. The resulting photographs are shown in the accompanying illustration and, in a stereoscope, plainly exhibit Jupiter's approximate rotundity, together with his slightly bulging equator.

There are two sets of photographs. The upper were taken with ultra-violet light and the lower with red. The procedure was to take first the right-hand pair and then, after an interval of eleven minutes, the left-hand pair. During this time, the planet's rotation amounted to six and two-third degrees, quite sufficient for the stereoscopic effect.

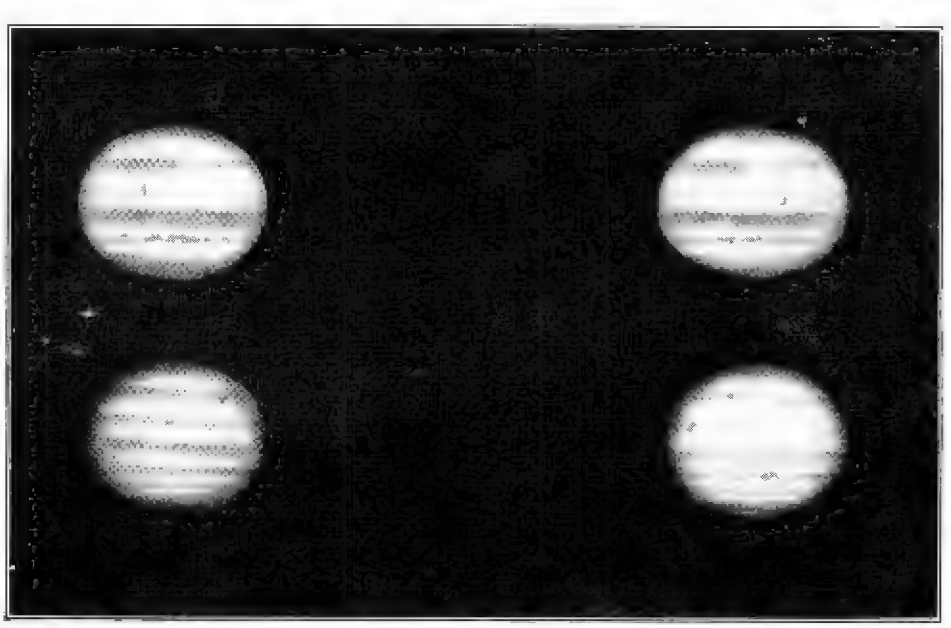
Notice the decidedly different aspect presented by the respective colors. Terrestrial experience indicates that the penetrating power of the red rays is greater than the ultra-violet, hence it is concluded that the top pictures reveal the structure of Jupiter's outer atmosphere while the red photographs depict a lower layer. Note the difference in intensity, form, and general appearance of the same belts at the two different levels.

The surface seen in either case is unquestionably gaseous—not solid—and the belts visible are streaks of floating clouds. Heat measurements indicate that the temperature of the planet is extremely low, about 120° below zero, Centigrade, and the clouds are, very likely, composed of some frozen material such as carbon dioxide snow. Their distribution in belts is parallel to Jupiter's equator.

"The great red spot," one of the best known and semi-permanent features is plainly shown near the upper limb on the violet photographs. Probably owing largely to its color, it is inconspicuous on the red views. This spot has been known since 1878; from that time till now it has undergone many variations in size, shape, and color. Then it was about 30,000 miles long by 7,000 miles wide—large enough to contain several bodies the size of the earth. After many years of inconspicuousness, it has again become plainly visible, though it has not regained its former prominence.

The black spot in the upper right is the shadow of the satellite, Europa. In the interval between exposures it has moved enough to vitiate the perspective—hence it appears to lie far above the planetary surface.

This method of presenting planetary views is more than an astronomical curiosity. The stereoscopic effect lends a semblance of reality to the picture even beyond what is ordinarily observed in a telescope. Many irregularities and odd formations, not at all prominent in the flat picture, stand out vividly in their three-dimensional aspect. The public will undoubtedly await with interest similar photographs of Mars and the other planets.



If you have a stereoscope view this picture in the regular position before the two lenses of the stereoscope, and you will be surprised to see Jupiter stand out in relief.

Jupiter has a breadth of 87,400 miles and is eleven times larger than the Earth, and only 1,000,000 times smaller than the Sun. The planets Mercury, Venus, the Earth and Mars combined would form an insignificant mass in comparison with this giant planet. The immense globe weighs 310 times more than our Earth, but its density is only one quarter of ours. Materials upon Jupiter are made of substances lighter than those upon the Earth, but as the planet exerts an attractive force 2½ times as powerful, they are in reality heavier and therefore weigh more. Seen in the telescope, the planet Jupiter seems to be enveloped in dense vapors.

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Home Movies

Conducted by DON BENNETT

Trick Work with Amateur Movie Cameras

A veteran parachute jumper brings to the public eye the thrill and effects which are seen in descending to the ground. A movie camera strapped to his head enables these extraordinary shots to be taken.
Photo courtesy DeVry.

"I SAW a wonderful picture last night, Mr. Jones." The speaker was one of Jones' newest customers and a persistent seeker of information. He was eager to learn all he could about his new hobby of movie-making and absorbed information readily. He continued, "I wish I could get some of the effects that the professionals do. I'm sure I could make my films more interesting to those who are not in them."

A TELEPHOTO TRICK

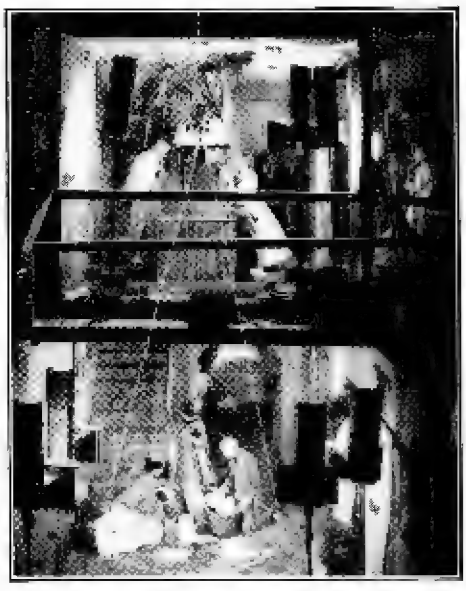
"THAT is the supreme test of an amateur film, to make it interesting to those who have no personal interest in it. But you need not worry about your lack of equipment. There are some very simple devices for amateur cameras, that when used properly, enhance the value and interest of your films. For example, this "iris vignetter" (Fig. 1) has a great many possibilities. While designed to act as a fade-out device, under certain circumstances it will serve the purpose of a telephoto lens. One of my customers while touring the Alps, wanted to get a picture of a friend of his who was scaling the face of a cliff. He was so far away that a telephoto lens seemed a necessity, but my customer did not have one. He attached his iris vignetter and, setting the camera on a tripod, exposed a few feet with the vignetter wide open, then with the camera still running, he slowly closed the iris until the climber stood out as the most important thing in the picture (Fig. 2). The slow contraction of the scene aided this illusion and he seemed to move nearer the camera as the opening grew smaller. The beginning of the scene established the location, a snow-covered cliff amid beautiful scenery, and the slow closing of the iris compelled the eye to concentrate on the subject, the climber.

"That is a stunt worth knowing. Are there any other uses for the iris?"

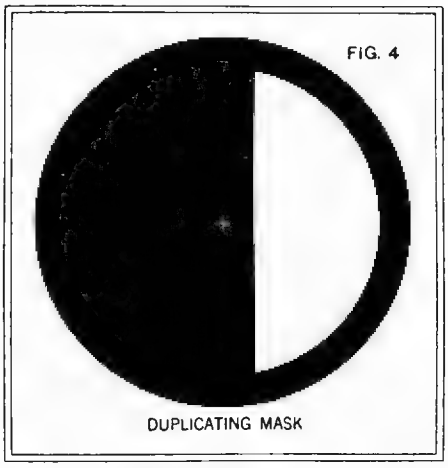
HOW TO FADE ONE SCENE INTO ANOTHER

"YOU can make a very intriguing lap-dissolve with it. A lap-dissolve, you know, is where one scene fades into another, a bit of each scene showing during the change. With professional cameras this is done by fading out on one scene and then winding the film back, after which the camera is faded in on the next scene. Of course the amateur has no fade-out device in his camera, so he must resort to other means. If you iris out at a steady rate and note the footage consumed, you reverse the film and iris in on the next scene. Of course amateur cameras are not yet equipped with means for turning the film back so we must put the camera in the darkroom or in a changing bag, which is a portable darkroom in which you can work by the sense of touch. You unthread the camera and wind back the amount of film that it took you to iris out. Then you rethread the camera and set up on the next scene. With the iris full-closed, you start the camera and iris in at the same rate of speed you irised out. This results, on the screen, in two circles growing in opposite directions and dissolving one scene into the next. A little practice is needed to turn back the film just the right distance but you will find it easy to do. It does not matter if you are a few inches off, but a perfect lap gives the best effect.

"Another good use for the iris is to elimi-



A very novel effect has been obtained in one of the commercial photoplays by mounting the camera on a platform suspended from a cable. The platform can be moved up and down, as shown above.
Photo courtesy Metro-Goldwyn-Mayer.



The above drawing shows the duplicating mask which makes it possible to take two pictures on one frame or four, as described in the text.

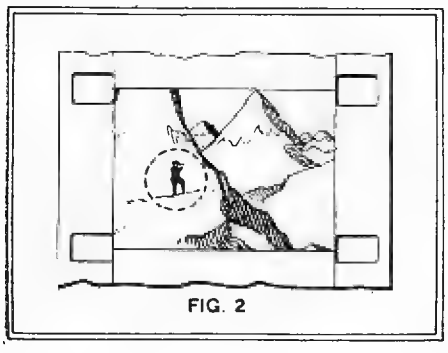


Fig. 2, at the left, shows how the effect of a distant view is obtained by means of an "iris vignetter." The distant figure seems to stand out as the "iris" is closed and compels the eye to concentrate on the subject.

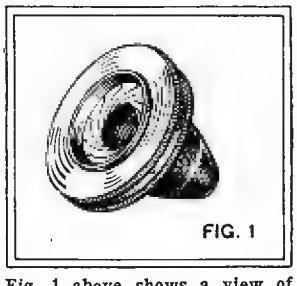
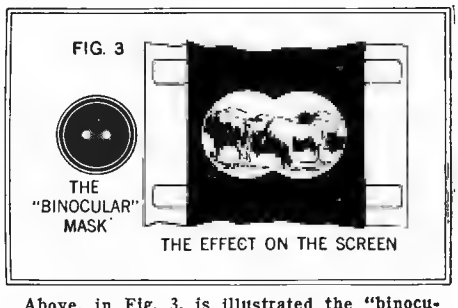


Fig. 1 above shows a view of the "iris vignetter" used to imitate telephoto shots.



Above, in Fig. 3, is illustrated the "binocular" mask and the effect obtained when this is used while taking the pictures.

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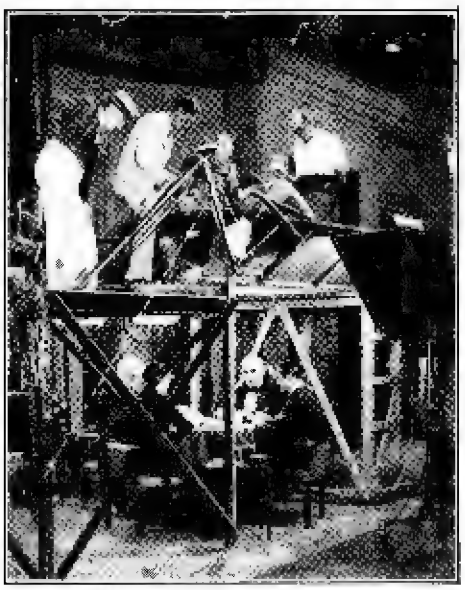
nate objectionable backgrounds when filming a close-up of a person. Just the head or the head and shoulders is included in the scene, the background fading away to dead black.

A piece of paper with two holes in it (Fig. 3) placed over the iris will give you the effect of binoculars, used to indicate that the scene being photographed is very far away, although you are really quite close to it.

TRICKS WITH A DUPLICATOR

"A 'DUPLICATOR' (Fig. 4) slipped over the lens or the vignetter will enable you to make people disappear in the center of the picture. They simply vanish in mid-air. The stunt is to place your camera firmly on a tripod, lined up so that a tree or post will be exactly in the middle of the scene. Then you take the scene with the lens covered and the people pass beyond the tree. When the necessary footage has been taken, you turn back in the same way I told you a moment ago, but without moving the camera. Slip the changing bag over the camera as it stands on the tripod and fasten it around the tripod head with a strap or heavy rubber band. When the film has been rethreaded at the beginning of the scene turn the duplicator around so that the first side of the film exposed is now covered and the unused side is brought into use. You can either run all the film off so that the people disappear or you can let a few seconds elapse until they walk beyond the tree again. The effect will be either that they disappear behind the tree, or that it takes them five or ten seconds to pass a tree only six inches in diameter.



Another "stunt" can be obtained by mounting a platform above a table and pointing the camera downward, as illustrated above. Photo courtesy First National Pictures.

street scenes from a second or third story window. Also shoot them from a few inches above the ground. Unusual shots of interesting buildings may be made by standing a few feet away from the base and pointing the camera upward. If you saw "The Crowd" you will remember the opening scene, where the camera went up the side of a building and then into one of the windows. This of course was done with special apparatus, but you can take a shot from the base and dissolve it into a shot from a more normal angle. Try shooting vertically downward from a high building. All these things help to make your films more interesting.

two feet into the dish containing the solution and slowly withdraw it. The reducer will bleach away the negative until at last nothing is left but clear celluloid. As you have pulled the film out of the solution gradually, and at a steady rate, the change on the screen will also be gradual until the screen goes black. If the film is pulled out too rapidly and all the emulsion is not bleached away from the end, it can be immersed again and pulled out a little faster this time. After the bleaching is finished the film must be thoroughly washed and dried before it is printed. If two pieces of negative film so treated are overlapped in printing, a lap-dissolve will result.

The same effect of dissolving can be obtained with reversal positives by bleaching the necessary two feet and overlapping them, splicing at only one end. This end should be the one that goes through the projector first. Care must be taken in rewinding to see that the loose end is carefully tucked in place or the film will buckle and break. It is, at best, a poor substitute. Fades cannot be made on reversal film in this way as the picture will fade out and leave a white screen, very objectionable to the eye.

PEOPLE WALK BACK-WARDS

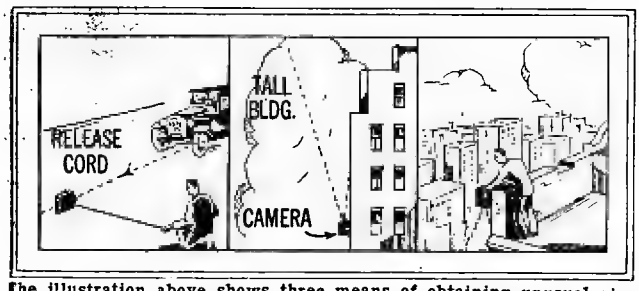
"THERE is another trick that usually provokes a laugh. When taking a scene, especially one with lots of action in it, hold the camera upside down. Then when the film is returned to you from the laboratory, cut out this section and reverse it so the pictures are head up. When projected the people in the scene will all move backwards in a most comical way. This trick is especially good for diving pictures, and if you can have someone right alongside of you shooting in the normal way, when the two are spliced together, the diver will jump into the water, and then amidst great splashing reappear, *feet first* and return to the diving platform and resume the normal position.

"If you shoot a few feet of a scene with no one in it and then stop our camera, place some one in the scene and resume shooting, the effect is rather startling. You can elaborate on this by substituting someone every few feet, until finally your audience will be lost in laughter.

"A lot of these tricks can be used in title-making, and I want to show you something about that the next time you come in."

Next month Jones and Blake will discuss the construction and use of a title outfit. Many money-saving ideas and short-cuts in title making will be explained.

(*Cont. on page 636*)



The illustration above shows three means of obtaining unusual pictures. Street scenes can be shot from the second or third story window.

At the right we see how it is possible to obtain four images on one frame with a duplicator prepared with a piece of black paper.

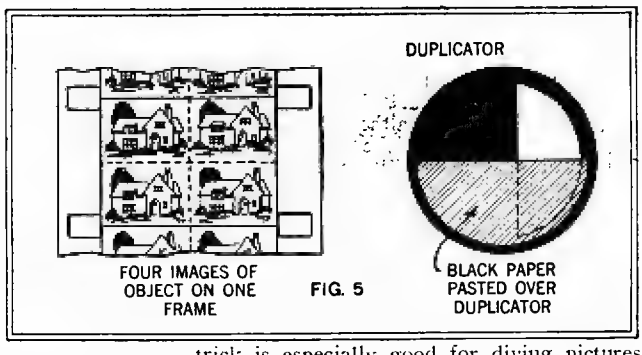


FIG. 5

FOUR EXPOSURES ON ONE FRAME

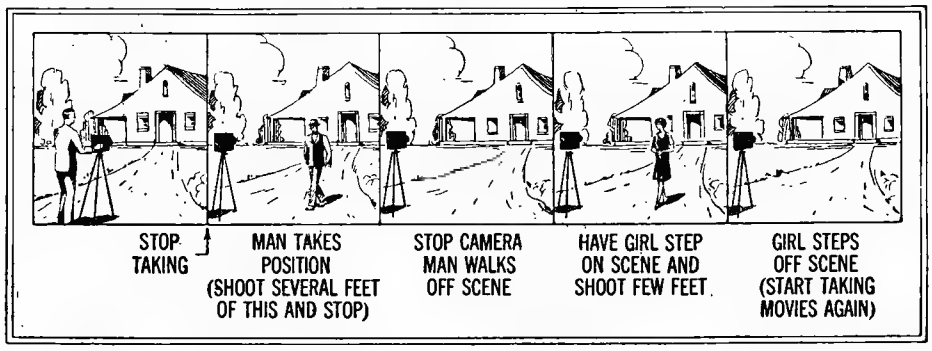
"THIS same duplicator with a slight change becomes a very effective piece of trick apparatus. Paste a piece of black paper over it so that the opening is covered in the same proportion that it originally covered the lens. By turning it four times, the screen is divided in four sections and shows four pictures at the same time. (Fig. 5). When doing these tricks it is best to have your view-finder marked off correspondingly so that you can govern the action. This can be done by gluing four hairs across it exactly bisecting the long and short dimensions. Your first few films might be poor trickery but you will soon learn what allowances to make and the only way to do this is by trial and correction.

"You will find that unusual camera angles will enhance the effect of your pictures. Watch the angles used in professional productions Sometimes it is placed low, and again it is high up. Put your camera on the ground and run an automobile over it. The effect is startling to say the least. Get up on a stepladder and look down on your friends, rig up a scaffold on two ladders and look down vertically on a table of cards or of people eating. Shoot

CHEMICALLY MADE FADE-OUTS

"YOU speak of fades and dissolves, Mr. Jones. Is there any way I can do these with my camera except by using the iris?"

"There is a device that will do this, or, if you use negative film, you can make chemical fades. To do this you make a weak solution of *Farmer's Reducer*. The weak solution allows a better control of the fade. A fade is usually five seconds in length, or two feet of sixteen millimeter film. Dip


STOP TAKING
MAN TAKES POSITION (SHOOT SEVERAL FEET OF THIS AND STOP)
STOP CAMERA MAN WALKS OFF SCENE
HAVE GIRL STEP ON SCENE AND SHOOT FEW FEET
GIRL STEPS OFF SCENE (START TAKING MOVIES AGAIN)

At the left is an illustration showing how some startling effects can be obtained by shooting a few feet of a scene, and then stopping the camera; someone is placed in the scene and the shooting is resumed. This can be elaborated on by substituting someone every few feet.

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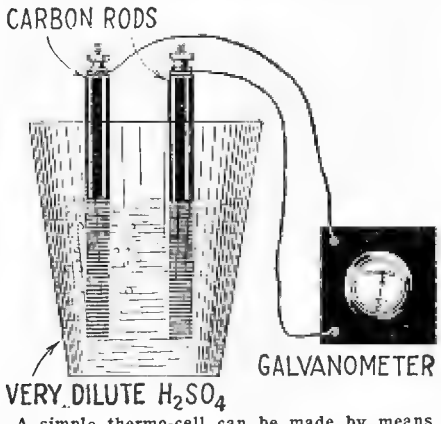
EXPERIMENTAL Chemistry and Electrics

A Simple Thermo-Cell

This thermo-cell can be made from materials within the reach of any experimenter



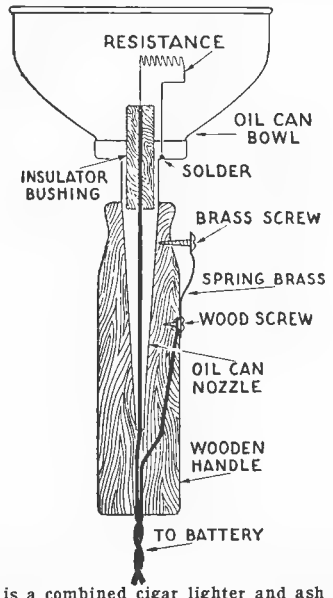
A simple thermo-cell can be made by means of two carbons and a solution of dilute sulphuric acid. Heat one of the carbons, plunge into solution and galvanometer registers.

and is much stronger than the thermo-couple, giving fairly good voltage and relatively high amperage. The strongest, as well as the simplest to make consists of two like conductors immersed in a very dilute solution of sulphuric acid. The electrodes are best made of carbon, although some metals are nearly as good. The carbon obtained from an old dry cell will answer. The acid should be diluted about 60 to 1. The cell is connected to a galvanometer or a millivoltmeter.

To operate the cell remove one carbon from the acid and heat it to about 60° C. Then plunge it into the acid, being careful not to let it touch the other carbon. A wide deflection on the galvanometer will be noted. This gradually decreases until the temperature of the two carbons is the same. Even the heat produced by the hand will cause a deflection. Care must be taken not to heat the carbon above the boiling point of water, as the acid will sputter and may cause serious results.—*Howard James.*

COMBINED CIGAR LIGHTER AND ASH TRAY

We publish the diagram of how to make



Here is a combined cigar lighter and ash tray easily constructed from an old oil can, some wood and a resistance unit taken from a radio rheostat.

Cigar Lighter and Ash Tray

a cigar lighter and ash tray for the autoist and radio owner, from odds and ends.

This is a photograph of the completed product. It will be observed that this lighter is both practical and neat. Its size can be compared with the battery clip.

The list of parts is given here. It includes one discarded oil can about two and one-half to three-inches diameter, ten or twelve turns of a 30-ohm rheostat, a wooden handle of a discarded soldering iron, one inch of insulating tube taken from the same soldering iron, and a strip of brass taken from an old-fashioned jack, a few inches of buss bar, one wood screw, one machine screw, solder and flexible wire. The construction is given completely in the illustration.

It will be observed from the illustration that the lead going to one side of the resistance passes through the oil can. This is insulated from the can. The other battery lead communicates with a piece of spring brass, to the end of which is soldered a brass screw. When this screw is pressed, it touches the side of the oil can, making contact therewith and closes the circuit through the resistance. As will be seen, one end of the resistance is soldered directly to the can. Of course the oil can has to have its bottom removed so cigarette can be brought in contact with the heated wire.—*Thomas C. Leid.*

Operating Cost of Electric Appliances

HOW many times have the majority of us wondered what the cost per hour was on certain electrical appliances which we use every day in our homes? Now that we have radio "A and B" eliminators that we merely plug into a light socket and sets that have no batteries —how much do we pay for the convenience and upkeep of these modern inventions? To be sure, most electrical appliances, such as grills, percolators, toasters and curling irons are marked in watts on the maker's nameplate and these are very easily figured out. We know that one thousand watts equals one kilowatt and all meters are read in kilowatt hours. If a toaster is marked 600 watts and we pay ten cents a kilowatt for our current, the toaster, of course, costs us six cents per hour to use. A cheaper rate for current naturally lessens the expense of using the appliance in proportion.

But what about it when an appliance is marked only in amperes, you ask? Simple enough. Amperes times voltage equals watts, and if the appliance is marked five amperes and our house voltage is 110—which usually is the case—we merely multiply them together and find that 550 watts is the result, or a cost of five and one-half cents per hour to use on the ten-cent rate.

One more question you throw back at me. Some eliminators and chargers have only the output current or voltage marked on them. What then? Now we must go to the meter itself, where, by remembering a few figures we can determine the cost per hour of anything we might connect to a socket. All meters have a constant which denote the wattage registered for one revolution of the disc, and by connecting to the circuit any appliance and counting the disc revolutions for sixty seconds, we can easily get the wattage for one minute. This figure is then multiplied by sixty, which gives us the total watt-hours of the appliance. For instance, the 5-ampere Sangamo meter's constant is 5/24. This means that each revolution of the disc is equal to 5/24th of a watt. Now, if we connect a charger to the circuit and count five revolutions of the disc in one minutes and multiply by the constant, we get the total of 25/34ths. Multiplied again by sixty equals sixty-two, which is the wattage we are using per hour. The charger then consumes only two watts more than a sixty-watt lamp, or a cost of 6/10th of a cent per hour to operate. The constant of the 5-ampere Wesinghouse meter is 1/3 and of the General Electric 3/10. We must, of course, remember to turn off all other load from the circuit to get the true wattage of our appliances.—*F. S. Saunders.*

KINKS ON REPAIRING ELECTRIC MOTORS

Small electric motors occasion trouble when the brushes become worn, and this condition is at once made evident by excessive arcing at the revolving part of the motor called the armature and commutator.

When the brushes are worn the motor will not pull or start as it should until new ones are installed, but before replacing them be sure to look for weak brush springs.

It is rather a simple matter to replace brushes on fan motors, or those of this type, as the motor need not be taken apart to do the work, the brushes (usually two) being held in holes in the motor housing on opposite sides, the pressure of a spring holding them against the commutator.

If the brushes do not show much wear try increasing the brush spring tension by stretching the springs a bit.

If it is necessary to take the motor apart to get at the brushes this should not be attempted until you have scratched a mark on both brush-holder housing and armature housing so that you will be able to reassemble it just as it is taken apart.

A button-hook is a handy thing to hold the brush springs out of the way while the brushes are being removed, or replaced.

Small round brushes that are used in many small motors can easily be made out of flashlight battery carbons. To reduce them to the proper size fasten them in the chuck of a breast drill, or brace, and fasten this in a vise, or hold it on the bench.—*G. F. Stillwell.*

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Food Adulteration

How to Detect Some Common Adulterants

By WILLIAM LEMKIN, Ph.D.

ALL foods, we have learned, contain a number of essential elements known as nutrients, each of which performs a definite function in our body. In a recent issue of SCIENCE AND INVENTION the writer outlined a series of elementary qualitative tests which the home chemist may easily perform to detect the presence of these nutrients. But we are sometimes confronted with the condition in which certain articles of our diet are discovered to contain substances other than the essential nutrient elements common to all our foods, and the unfortunate part is that these foreign ingredients, or adulterants, may be harmful to your health.

TYPES OF ADULTERATION

BY adulteration is meant the altering of the normal composition of the food. It is accomplished in various ways:

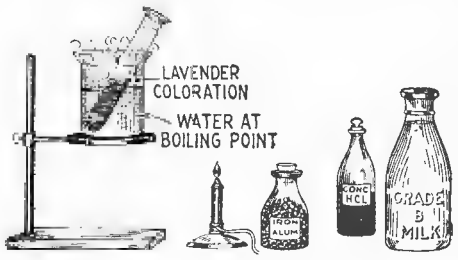

Fig. 1. A simple test to prove the presence of formaldehyde as an adulterant in milk.

1. By adding to the food some foreign material to lower or injure its quality or strength.

2. By substituting, either in part or completely, some inferior substance for the proper one.

3. By entirely removing a portion of the valuable ingredient from the food.

4. By the addition of some artificial coloring or flavoring material so as to conceal its inferior quality, or to make the food look better than it really is, or simply more attractive.

5. By mixing with the food some poisonous ingredient or any constituent that might be harmful to the consumer.

Adulteration then may be harmful, fraudulent or accidental. Harmful adulteration includes all those which are either directly harmful by the addition of injurious substances, by the decomposed or unwholesome state of a part or the whole of the food, or by the dilution or extraction of some nutrient part of the food, thus rendering it less nutritious. Under fraudulent adulterations are classed all those which do not directly or indirectly harm you except in deceiving you, and making you pay more than you would normally have paid. Accidental is where the change was not made on purpose.

Although most forms of food adulteration are harmless to your health, resulting only in a raid on your pocket-book, there is one common and outstanding type which might undoubtedly result in injury to your body. That is the use of chemical preservatives in certain classes of food. In recent years the practice of adding preservatives to food has greatly decreased. These chemicals, such as boric acid and benzoate of sodium, preserve the food by preventing the growth of bacteria. There may be difference of opinion in regard to the use of some of them, but it seems perfectly reasonable that antiseptic substances which will prevent the decay of food will be likely also to interfere with the digestive processes, and prove injurious to the system, especially in the case of invalids and young children.

In the testing of various foods for adulterants the home experimenter has a highly fascinating field for chemical research along truly practical lines. How often have you doubted the purity, wholesomeness or high quality of a certain food, such as milk, meat, butter, tomato catsup and a host of other articles on your dinner table? How many times have you wondered if a highly-colored jam or fruit extract really owed its brilliant hue to the natural fruit or berry? Thanks to the work of scores of patient analysts and food chemists we have succeeded in standardizing the various tests to such an extent that it merely requires a few simple manipulations to unearth the cleverest and most deep-seated forms of adulteration practiced by unscrupulous food manufacturers and dealers today.

HOW PURE IS YOUR MILK?

THE most nearly perfect of all our foods is milk. It is commonly adulterated by the addition of water, or the removal of part of the cream. This fraud, however, may be detected with comparative ease by the use of a specially graduated hydrometer or lactometer, which measures the specific gravity of the milk, and records the dilution (not necessarily fraudulent). Another common adulteration is the treatment of the milk with various chemical preservatives, especially in warm weather, to delay its souring. Formaldehyde, or "formalin," is the substance frequently employed for this purpose. If you but consider that this chemical is one of the chief ingredients of embalming fluid, you can realize the grave danger in its use for preserving the primary food of infants and invalids.

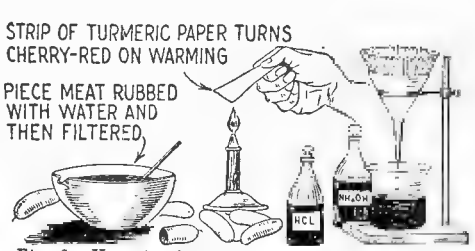

Fig. 3. Here is shown a test that will detect the presence of boric acid or borax in meat.

To test for formaldehyde, place a small quantity of milk in a test tube. Add an equal quantity of strong hydrochloric acid, and a piece of iron alum about the size of a pinhead. Mix the liquids with a gentle, rotary motion to break up the curd. Place the test tube in a beaker of water after the water has been brought to the boiling point, and leave it there for five minutes. When formaldehyde is present, there will appear a purplish or lavender coloration. If this preservative is absent, the solution slowly turns brown.

After milk has partly decomposed, with the formation of lactic acid, the latter is often neutralized by the use of baking soda, or sodium bicarbonate. To detect the presence of this adulterant, a sample of milk is evaporated down to dryness on a water bath, and the residue ignited to obtain the ash. After cooling, add a drop or two of hydrochloric acid, and notice if there is any effervescence, which would denote the presence of carbonates.

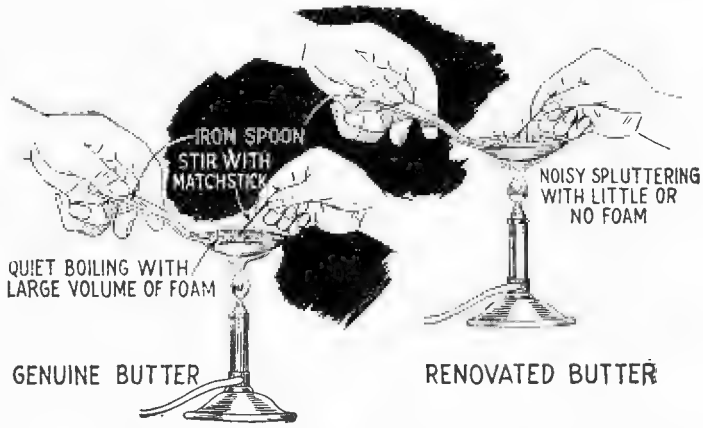

Fig. 2. This easy test gives an unmistakable proof as to the genuineness of your butter. The amount of foam tells the story.

"RENOVATED" BUTTER AND OLEOMARGARINE

WHEN butter has become old, rancid and unsalable, it may be "renovated," and made to resemble the fresh article. The process consists of melting the butter carefully, removing the curd and brine, blowing air through the mass to remove the disagreeable odor, and then mixing with milk and churning. Some states require that this product should be marked "Renovated Butter" when exposed for sale, while others allow dealers to handle this form of butter without restriction.

Artificial butter, butterine or oleomargarine is a common form of butter substitute which, although made from natural fats, and considered as perfectly good food, is sometimes mixed with genuine butter, and, as such, falls into the class of adulterants, in the sense that it lowers the nutritive value of the butter and constitutes a fraud. To distinguish between genuine butter and "renovated" butter, the simple boiling test is employed. Heat a sample in an iron spoon over low flame, stirring constantly with a matchstick. Boil the butter briskly, stirring thoroughly. Genuine butter will boil quietly, with the production of considerable froth or foam, which may even boil up over the

(*Continued on page 654*)

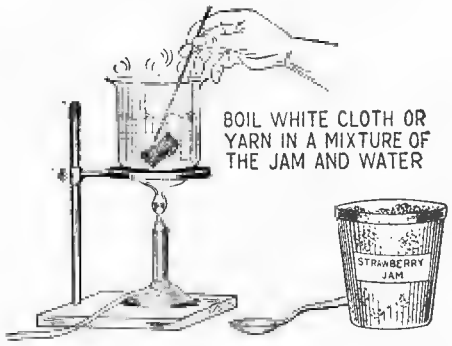

Fig. 4. If your fruit jam is colored with a coal-tar dye, the piece of cloth will develop a bright tint in this test. Natural colors are dull.

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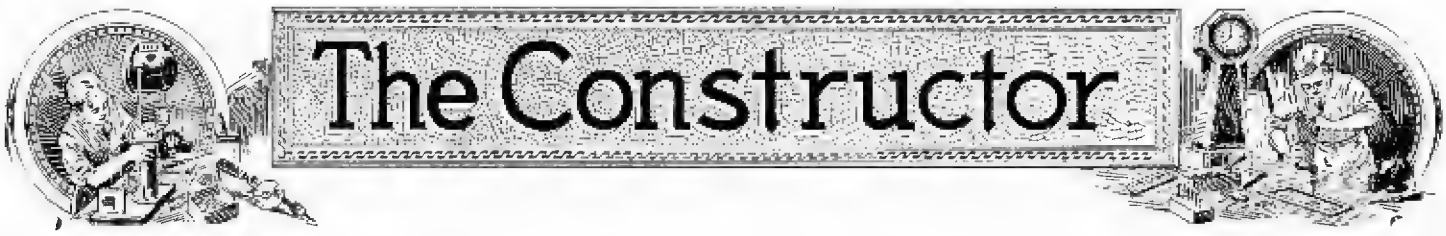
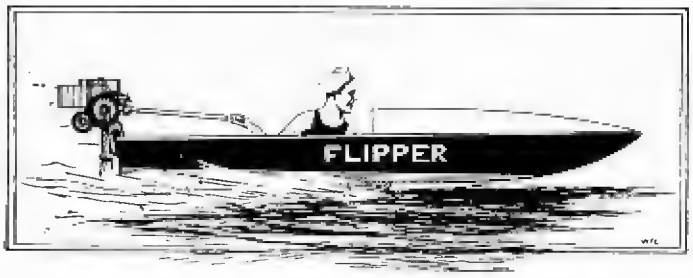


Building an Outboard Motor Hydroplane

Little Boat is Eleven Feet Long and of the Simplest Construction. With Suitable Motor, Speeds in Excess of Twenty-five Miles an Hour are Quite Possible.

By W. F. CROSBY

THE advent of the outboard marine motor has opened up an entirely new field for small, light race boats, boats that can be made for an extremely small sum of money, are relatively safe and



The picture at the left shows the appearance of the outboard motor speedboat here described when it is skimming along at a good rate of speed. The Boat rides very high in the water, as will be seen, and quite a little skill is required in maneuvering the craft.

are capable of speeds sometimes in excess of thirty miles an hour—a real thrill on the water. "Flipper" is such a boat. She is eleven feet long and fifty-five inches wide at the widest point. Flat bottomed, straight sides, she is easy to make and anyone who is at all familiar with a saw, hammer and plane should have no difficulty in putting her together in a week's time at the outside.

The sides are brought in at the bow and the bottom comes up to form sort of a "sled-nose," which will permit her to rise up on the surface and skitter along with the best of them. There is no steam bending in her construction and the slight bends in the sides and bottom may be worked easily from ordinary lumber of the proper thickness.

BUILDING THE FRAMES

IN the detail drawing, at the top, will be found the complete dimensions, and the first thing to do is to make full-sized drawings of the sections, or frames. With an ordinary six-foot rule and a square of some kind, these dimensions should be drawn directly on a fairly smooth floor. When the material for the frame is ready, it may be laid on these full-sized sections, one section at a time, and the boards screwed together by the corner brackets at exactly the proper angles for the bottom and sides. A temporary piece should be nailed across the top to hold the sides securely until the planking is in place. There are four of these frames and they are spaced exactly two feet nine inches apart. The bottom is a perfectly straight line, and the frames may be temporarily nailed down to the floor at their proper spacing, after notches for the chine have been cut at the lower corners.

The next step is to get out the stem block. This may be a piece of oak or other hard wood about six inches square and roughly tapered to about the shape shown in the perspective drawing. It may be built up from several thicknesses of wood. The planking is fitted into a notch around the edge of this piece so that the surface, when finished, will be smooth.

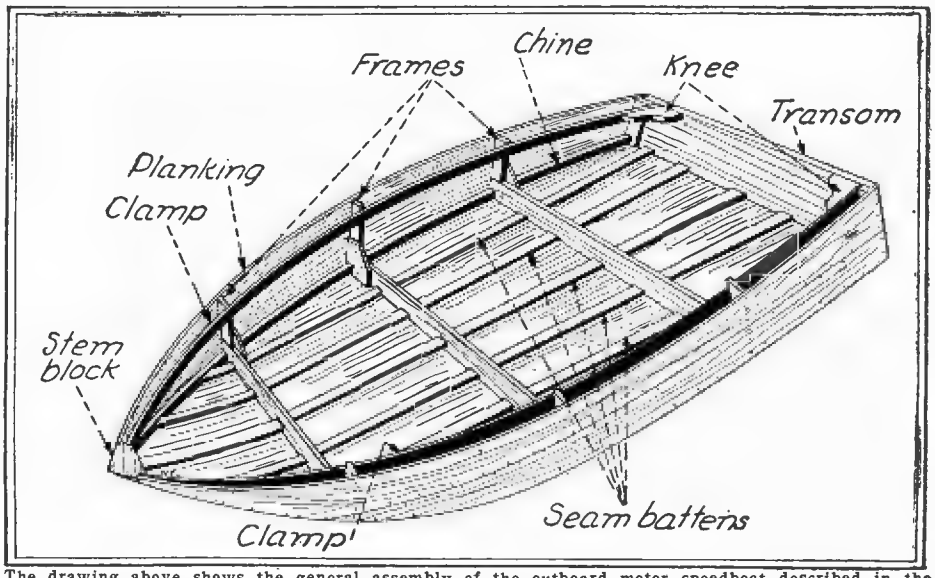
SIDE PLANKS

WE will now lay this piece aside and proceed with the side planks. These may be made from one piece (on each side), but may be built up of two each if wood of the proper width cannot be secured. The maximum width is twelve inches. One edge of one of these planks should be made perfectly straight, and from this the right-angle lines representing the spacing of the frames may be laid in. The length of each plank should be about twelve feet, to allow for the bend and to allow for trimming off at the ends. From the top drawing in the larger group it is now an easy matter to lay off the distances, 12 inches, 11¾ inches, 11½ inches and 11½ inches at each of these frame lines. The other edge is now trimmed down with a plane so that it is a line passing through each of these dimensions. The underside of this plank from station 0 to 1 is a slowly developing curve which may be easily planed down. It should fair into the rest of the lower line. When one plank is complete, the one for the other side should be marked out and then cut down until it is exactly the same size and shape.

We now turn back to the frames. Here we have the one inch square notches cut into the lower corners for the chine piece and this should now be fitted and screwed fast to each frame. The under side of the stem piece or block should be chiselled out to take the forward ends of these chine pieces and after screwing one side fast, the two chines may be bent in slightly and wired together so that the other chine piece can be screwed fast. When secure, the wire is taken off. This stem block should now be raised to its proper height, so that the upper edge will come in a straight line with frames 1 and 2. By nailing a piece to the back of this block and also to the floor, it will be possible to hold it securely in place. Side braces might also help matters. Be sure that your chine pieces run in fair to the stem block.

The side planks can now go on. Start in by fastening them into a groove at the stem block, using heavy brass screws for the work, and then bend them gradually, one at a time, until you are able to screw them fast to the first frame. Go on back, one frame at a time, screwing fast first one side and then the other, until you reach the third frame. The transom or stern is, of course, all one piece, made to the dimensions as shown, and this should be in place on the floor. The edges of the planking will overhang the edges of the stern but before you set this member up, notice that it is on a slight slant. The upper edge is 2 feet 9 inches from frame 3, but the lower edge is one inch less. The bottom should be cut at the proper bevel so that the bottom planking, when we come to it, will be laid up flush against the wood of the transom.

The side planking is now complete on both sides. It is screw fastened to the frames and along the chine pieces, making a rigid structure which will now make it possible to unfasten the frames from the floor and turn the boat over. However, it would be better to first put in the clamps along each side up under the top edge of each frame. These clamps are of light material, ½ inch



The drawing above shows the general assembly of the outboard motor speedboat described in the present article. The seams are covered with wooden battens as shown, and detailed instructions are given in the article for cutting and assembling the various wooden members.

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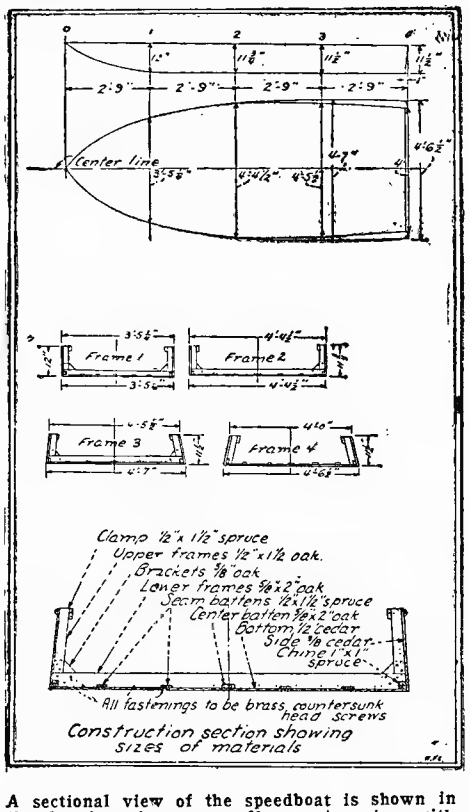
by 1½ inches spruce and should be pushed forward and cut to exactly the right length so that one end will butt up against the stem block and the other inside the transom, taking in the bend of the side. It will be necessary to remove the temporary cross pieces across the frames before these clamps can be screwed into place. They are fastened to the stem block and to each frame, as shown, and finally to the transom.

THE TRANSOM

THE transom, since it carries the load of the motor should be somewhat heavier than anything else in the boat and for this reason it is advisable to have it about 1¼ inches thick and made of oak or mahogany. Where the clamps come to the transom, small natural wood knees are screw fastened to the clamps and to the transom in such a way that the entire structure is extremely rigid.

We can now turn the boat over and begin work on the bottom. Here, in order to make a tight job, it is necessary to resort to what is known as seam batten construction. In other words, each seam or "crack" where the edges of two planks come together, is backed up by a light strip, fastened to each by screws and made tight enough to keep the water out. Sometimes, marine glue is put on the under side of the seam batten so that when it is tightly fastened down, the glue will make an absolutely leak-proof joint.

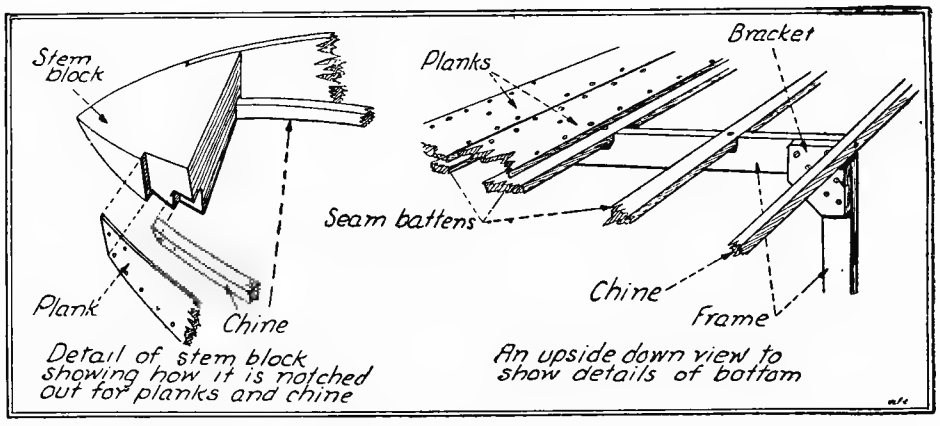
These seam battens are shown in the various sections. The one forming the keel is slightly heavier than the others and each is notched into the under side of the frame so that the planking, when it goes on the bottom, will fit up flush against the frame and battens. The planks, like the sides, run for and aft and there should be a seam batten at each joint. These battens are equally spaced out from the center one at the keel and run from the inside of the transom to the chine piece. The center one goes to the underside of the stem block, where it should be notched into place and securely screwed down. Six planks are shown on the bottom of the boat in the drawing, but if you can get wider planks, you may reduce this number. It may also


Center line
Frame 1
Frame 2
Frame 3
Frame 4
Clamp ½"x 1½" spruce
Upper frames ½" x 1½" oak.
Brackets ⅜" oak
Longer frames ⅜ x 2" oak
Seam battens ½" x 1½" spruce
Center batten ⅜ x 2" oak
Bottom ½" cedar
Side ⅛" cedar
Chine 1" x 1" spruce
All fastenings to be brass countersunk head screws
Construction section showing sizes of materials

A sectional view of the speedboat is shown in the drawing above, as well as a top view with dimensions, and also the sizes of the various frames.

be necessary to use narrower planks, depending upon the stock of the local lumber yard.

Start in by getting this data correct and then cut out the notch for each seam batten so that it is a nice fit. A single screw



The details of assembly are shown at some length in the illustration herewith. The picture at the left shows how the plank and chines are fitted to the stern block.

through seam batten and into the frame will hold it securely in place.

PUTTING BOTTOM ON

WHEN this work is complete, take a perfectly straight edged piece of the bottom planking and lay it on so that one edge exactly halves the center batten or keel. It should be fastened to the under side of the stem first so that the bend may be easily made. Then proceed to fasten it down to frame number 1, 2, 3 and the stern in turn, until it is fastened by about three screws to each frame. It is screwed to each of the side seam battens by screws, through the planking and into the batten, arranged at intervals of about one inch to make the job tight. If you have done the work properly, the edge of this plank, away from the center batten, will exactly halve the next seam batten out toward the chine and it is screwed to this member just as to the keel batten. The edge of the plank, toward the chine and after it is screwed down, may be treated with a little marine glue and the next plank, pushed securely up against it and screwed down in exactly the same manner. Plank after plank follows until the entire bottom is covered and securely screwed to frames and battens. The edge is, of course, screwed to the chine piece and the excess wood of the sides or bottom is planed off to the proper line.

Each of the planks in the side and the bottom should be in one full length throughout the boat. Lumber of this length is easy to get and a joint will make a small boat weak and it will surely develop a leak. The bottoms of these little hydroplanes are subjected to heavy strains and they must be made strong enough to take these. The seam batten construction does much toward aiding this condition.

Each joint should be treated with marine glue and the entire hull sandpapered as smooth as possible. Be sure that the heads of all screws are countersunk flush with the surface of the wood and that the slots in the screw heads run fore and aft. This will prevent some friction and everything counts. Get that bottom as smooth as you possibly can and after you have given her a coat of paint, proceed to sandpaper it again, after the paint is dry. The smoother you can get it the faster she will go. The inside, too, should be painted to preserve the wood and the forward end may be covered over for about half the boat's length by a light canvas deck supported on light wooden frames. A few slats should be tacked down to the frames to make a floor so that you won't sit directly on the bottom of the boat.

In operation, the weight of the motor being way in the stern, it is necessary that the operator be in a reclining position usually pretty well up toward the middle of the boat as shown in one of the drawings. The steering may be accomplished by a long tiller arranged on the engine or by a small steering wheel just under the canvas deck

KEEL CONSTRUCTION

THE bottom of the boat has a fin keel to prevent side slipping on the corners. This keel is made up of a piece of twelve or fourteen gauge galvanized steel or brass plate, with one edge bent over and drilled with a number of holes to take screws by which it is fastened to the center of the boat at a point just a little forward of frame 2. This keel should be about a foot deep and a foot fore and aft at the upper edge, slightly tapered. The after edge of the keel should be just about even with frame 2, thus making the rest of it come forward in the proper location.

There are all kinds of engines available for such boats and of course the larger the motor the more speed obtained. However, "Flipper" is a rather small craft and we should not overload her with a great big motor. One of the ordinary two-cylinder motors will be just about right.

If you can't swim, don't take a boat of this sort away from the dock because when at high speed things are apt to happen quickly if you bump into the swell of some other boat at the wrong angle. The boat, under ordinary conditions, is stable enough, but with all the weight out of water at high speed, a bump at the right spot will turn her over quickly. Any speed boat is subject to this. Unless "Flipper" is greatly overpowered, she will make a fast little hydroplane, safe enough for all ordinary work and the next best thing to flying through the air.

When powered with a suitable outboard motor, the boat described here is capable of making a speed of thirty miles an hour. The craft is relatively safe due to its flat bottom and straight sides, which also enable it to be constructed easily. There is no steam bending needed and the curved portions can be easily made from ordinary lumber. The bottom of the boat has a thin keel so that it will not slip sideways when taking corners. It is important to treat each joint with marine glue, so that they will be water-tight. The smoother the surface of the boat is made, the faster it will go. The heads of all the screws should be countersunk, and the surface sandpapered, after which it is given a coat of paint. When the first coat is dry, it is again sandpapered and repainted. A few slats tacked on the floor will provide a suitable seat for the operator. Steering may be done with a long tiller, as shown in the illustration, or a small wheel may be arranged under the desk.

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Wood Turning for the Amateur

By H. L. WEATHERBY

Article No. 5 of a Series

FRENCH POLISHING AND OTHER FINISHING

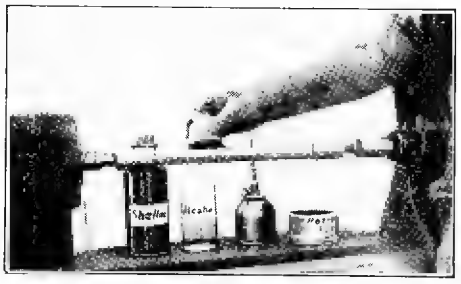
LAST month we promised that in this article we would take up some of the points of French polishing; and while we are discussing that we will also consider very briefly other methods used in finishing turned work.

Several small articles, most of which should be finished natural are shown in the drawings. Only very general dimensions are given and where desired the design can, of course, be changed to suit the individual. There is no particular sequence used; for if previous exercises have been followed carefully the readers of these articles should by now have a very good foundation for all future work in the art of wood-turning, and from now on we will deal with the kinks and the frills; rather than the regular turning; which simply calls for practice and more practice for the development of skill.

For those of an athletic turn of mind, the Indian club and the dumb-bell will be of interest. They are of a size to be of correct weight if made of hard wood; maple preferred. On the dumb-bell a little additional practice in turning a sphere is to be had, but it will not prove to be so difficult as turning the croquet balls were last month.

The vise handle should be of interest to everyone in a home workshop, for vise handles are forever breaking. The construction is plainly illustrated and naturally it will be nearly as good a handle if it does not receive a French polish—but not quite. It should be made of straight grained hickory.

The gavel differs in no respect from the mallets made previously and we suggest black walnut, mahogany, or maple for this.



The polish is applied by holding the pad lightly against the revolving piece of work.

Next we offer the tie or towel ring. It really calls for some rather expert turning, and offers something new, in the turning of the rings, which is done by the aid of a chuck. The drawings illustrate the steps in the turning of this ring, while the standard on which it is mounted may be turned either between spindles or on a faceplate. The ring, after it is turned and polished, should be split very carefully, placed through the hole on the standard in which it should fit loosely, and glued back together. If carefully done, the finished article will be a credit to any craftsman.

And last, we have the match box, which will be welcome on any smoker's table.

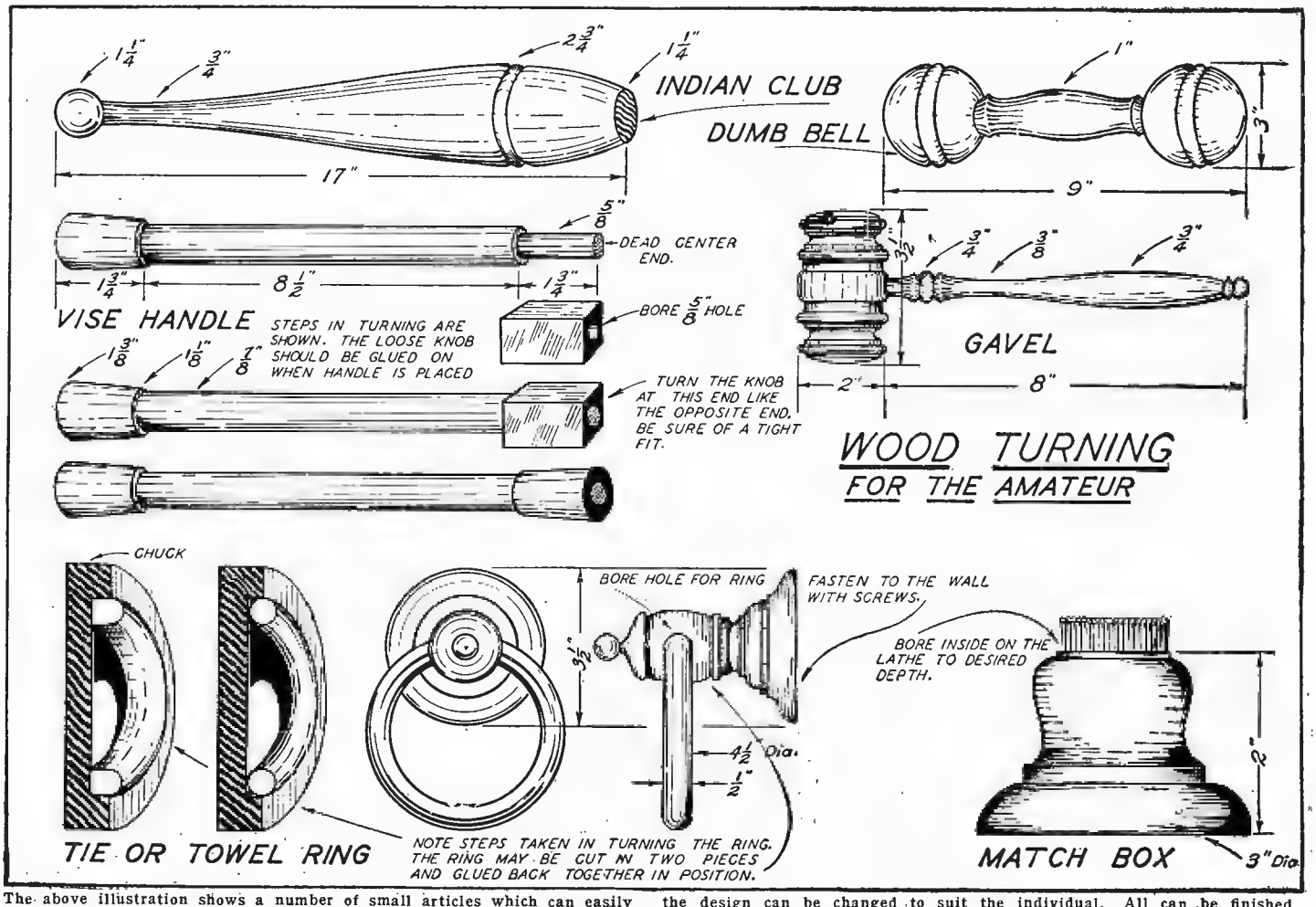
Having turned one or more of these articles and sanded them carefully with "o" or "oo" sandpaper preparatory to finishing, we are ready for the application of the French polish. It is well to keep in mind that vibration is ruinous to a good finish, so do not turn the ends down smaller than about ⅜" or ¼", and then to further avoid vibration operate the lathe when it is set in motion for polishing, at a medium speed.

MATERIALS REQUIRED FOR POLISHING

WE will need the following materials for the polishing. A wide-mouthed bottle holding shellac; a similar bottle but with smaller mouth for alcohol; a filled oil can with a spout; some cotton waste; a small quantity of rotten stone, and a piece of cheese cloth. For filling open-grained woods the ordinary methods for filling are used and fillers will be needed where such woods are used. Close-grained woods will prove to be more satisfactory for beginner's use. The wood may be stained before polishing.

For beginning operations we make a small pad of the cotton waste wrapped about with cheese cloth. Now hold the pad over the mouth of the shellac bottle and tip the

(*Continued on page 667*)


INDIAN CLUB
DUMB BELL
17"
9"
DEAD CENTER END.
VISE HANDLE
STEPS IN TURNING ARE SHOWN. THE LOOSE KNOB SHOULD BE GLUED ON WHEN HANDLE IS PLACED
BORE 5/8" HOLE
TURN THE KNOB AT THIS END LIKE THE OPPOSITE END. BE SURE OF A TIGHT FIT.
GAVEL
WOOD TURNING FOR THE AMATEUR
CHUCK
BORE HOLE FOR RING
FASTEN TO THE WALL WITH SCREWS.
BORE INSIDE ON THE LATHE TO DESIRED DEPTH.
TIE OR TOWEL RING
NOTE STEPS TAKEN IN TURNING THE RING. THE RING MAY BE CUT IN TWO PIECES AND GLUED BACK TOGETHER IN POSITION.
MATCH BOX
3" Dia.

The above illustration shows a number of small articles which can easily be turned in a lathe. Only general dimensions are given and where desired the design can be changed to suit the individual. All can be finished with French polish, as described with full details in the text.

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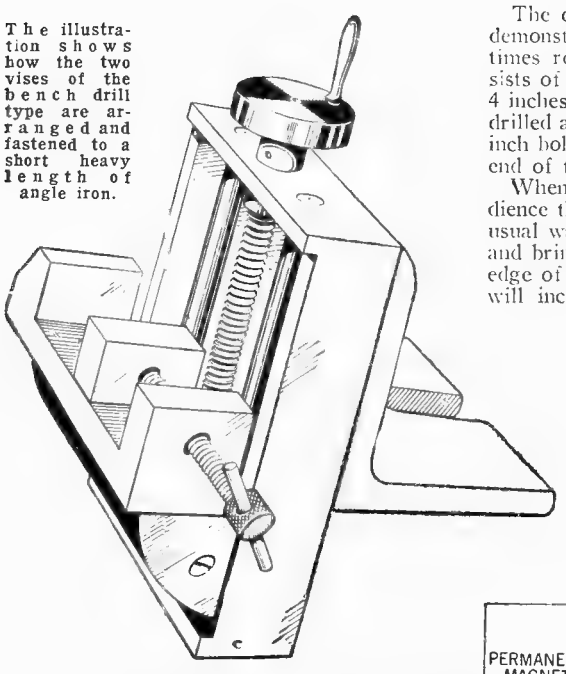
How to make it

ARTICLES OF INTEREST TO EVERYONE

THREE USEFUL IDEAS

MILLING WITH A LATHE

The illustration shows how the two vises of the bench drill type are arranged and fastened to a short heavy length of angle iron.



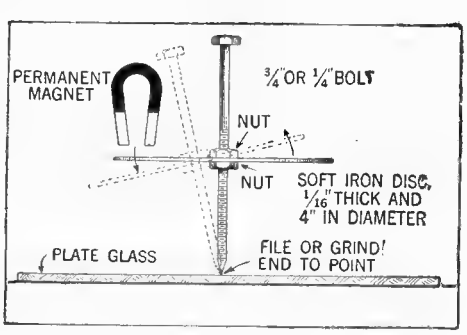
The tange is cut off of the large drill vise, and it is further altered to perform as the vertical feed. The small drill vise is mounted on the movable jaw and holds the work being milled. The large vise frame is now screwed to a short heavy length of angle-iron. The handwheel attached to the lead screw might well be an old pulley with the groove turned off; a short length of cylindrical rod serves as a handle.—*Joseph Pignone.*

A MYSTERY TOP

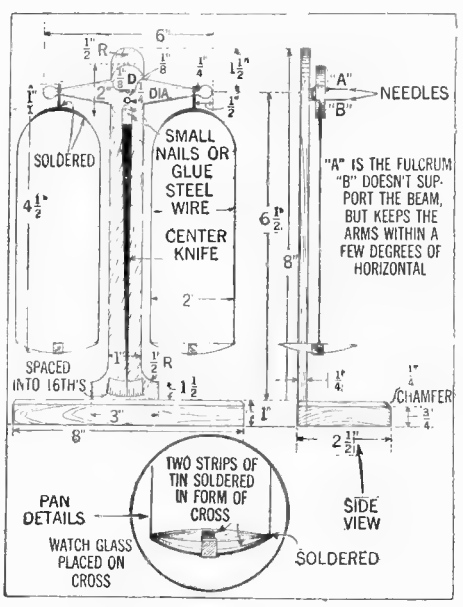
The outfit described here may be used to demonstrate that a piece of soft iron is sometimes repelled by a magnet. This top consists of a soft iron or a soft steel disc about 4 inches in diameter, 1/16 inch thick or less, drilled at its center and clamped to a 6- or 8-inch bolt by two nuts, as shown. The lower end of the bolt is ground to a point.

When about to demonstrate, show the audience that a magnet attracts the disc in the usual way, then spin the top on a glass plate and bring the magnet near to the disc. The edge of the disc will be repelled and the top will incline noticeably. This action is due to the eddy currents generated in the disc, the magnetic field due to this current is in opposition to the field of the magnet, with the result that the iron disc is repelled by the magnet—but only while it spins!—*C. A. Oldroyd.*

The illustration below shows the surprising action which takes place when a magnet is brought near the rotating disc.



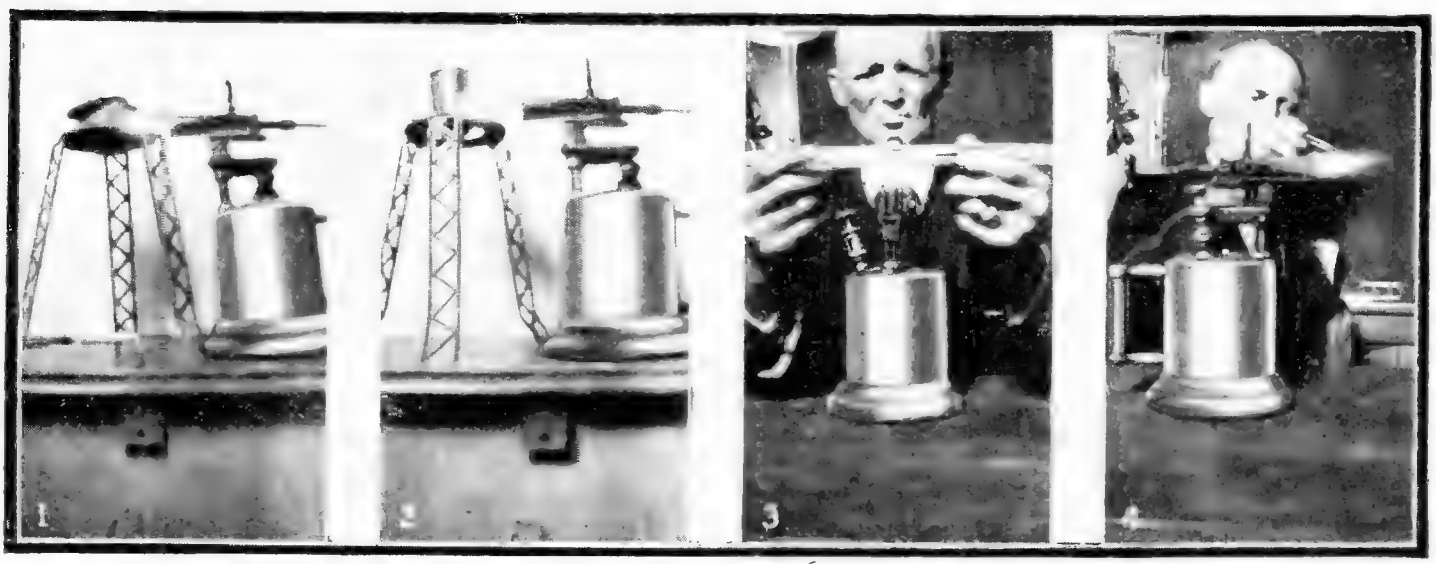
SENSITIVE BALANCE



The construction is illustrated in detail in the front and side views shown above.

The needle at A is the fulcrum, the needle B functions to prevent the balance arm from rocking too far from the normal horizontal position. The "center knife" or pointer may be made from a thin steel wire hammered into a long thin tapered shape, as illustrated. After being shaped, the pointer may be heated to a red heat and cooled suddenly, thereby hardening it. If the needle is too brittle it should be polished and reheated evenly to a light blue color.—*Stanley Oliver.*

Gasolene Torch Useful in Laboratory



An alloy is being melted by the torch in an ordinary crucible.

A similar operation is being conducted here with a sand crucible.

The torch is admirably suited to glass working in the laboratory.

It may be used for making flame tests also.—F. R. Moore.

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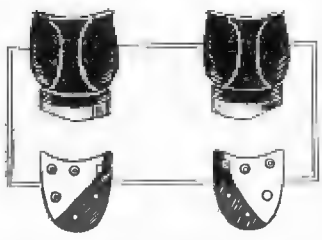
Wrinkles

RECIPES & FORMULAS

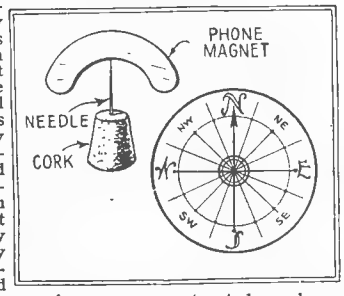
Edited by S. Gernsback

SAVING RUBBER HEELS



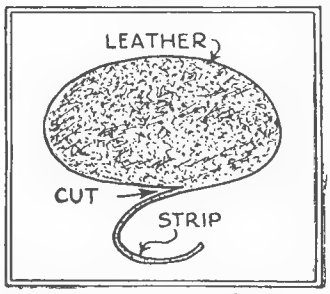
The useful life of rubber heels may be considerably extended by placing the left heel on the right shoe and the right heel on the left shoe, when one side of the heel is almost worn out, as shown in the illustration. This exchange of heels should, of course, be made before any part of the heel is completely worn down.—D. S. Jenkins.

MAGNETIC COMPASS



The experimenter very often has use for a compass, but many of the commercial compasses have very weak magnets and poor bearings, with the result that they are easily demagnetized and become useless. A compass constructed as shown here can hardly be improved upon for ruggedness. This compass will, of course, require a longer time to come to equilibrium than the usual type.—F. Schmulowitz.

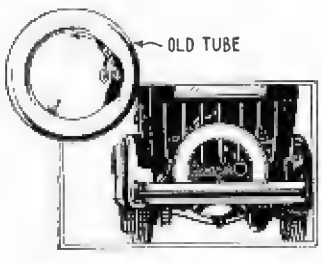
LEATHER SAVING



Instead of throwing worn-out leather goods away immediately, it would be advisable to cut a circular or elliptical piece from the article as large as possible. This piece of leather can be cut in such a way that a leather thong ten feet long or longer may be secured. Pieces of flexible leather are very handy at times, and leather strips can be made into such things as bridles, belts, quirts, etc.—John Matson.

SPARE TIRE COVER

An old inner tube may be slit with a pair of shears as illustrated, the valve removed, and may then be slipped over the tire. — K. Koochi.



RESTORING FADED PHOTOGRAPHS

It occasionally happens that one has a photograph of an old friend or relative, with which he is loath to part, but which has become yellow and faded with age.

The simple method described in this article will restore to such prints much of their former color and brilliancy, provided of course that the directions are carefully and faithfully followed.

First of all make the two following solutions:

A:—	Distilled water	5000 parts
	Sodium Tungstate	100 parts
B:—	Distilled water	400 parts
	Carbonate of lime (pure)	4 parts
	Chloride of Lime	1 part
	Gold and Sodium Chloride	4 parts

All parts by weight.

Make the solutions in the order given, and keep solution B in a glass stoppered bottle of dark color, preferably yellow, and let it stand for twenty-four hours, at the end of which time filter into another similar bottle.

Remove the prints from their mounts and wash well, and place in a bath composed of 150 parts of "A" to 6 of "B," in which they are to be left for about ten minutes, during which time they will gradually assume a purple tone, when they are washed for half an hour in running water, and then fixed in a mixture of 150 parts of "A" and 15 parts of Sodium Hyposulphite, until all trace of yellow has disappeared. This may take from a few minutes to six or seven hours depending on the condition of the prints.

After the prints have attained their proper color they are washed in running water for several hours and then mounted in the usual manner.

It is the writers advice to make the first few experiments with prints that are held in no particular esteem, until the knack of doing it is obtained—*Contributed by Ivan Haffenden.*

PURIFYING WATER

One drop of ordinary tincture of iodine mixed with a quart of contaminated water renders it safe for drinking purposes in 30 minutes. This method, while not recommended for general use, will be found very handy for campers or travelers who may have occasion to use water suspected of containing dangerous impurities.

SEAL AND LABEL GUMS

A good recipe for gumming seals, stamps, labels, etc., is as follows:

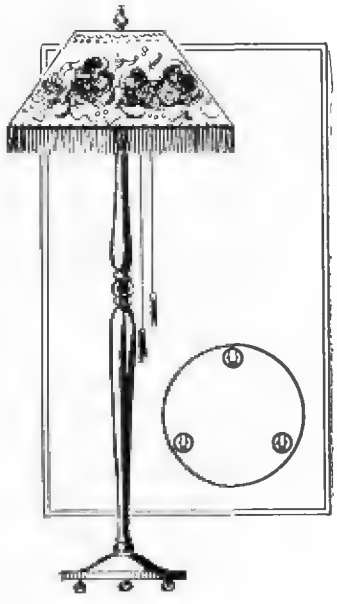
Mix 5 ounces of water, 1 ounce acetic acid, and 1 ounce grain alcohol (ethyl alcohol). Dissolve 2 ounces of Dextrin in the mixture, apply to the paper and allow to dry thoroughly.

Another recipe not requiring grain alcohol is the following:

Dissolve 1 ounce gum arabic (or dextrin) in a little water, add 4 ounces of sugar and 1 ounce of starch. Boil on a water bath until the starch is dissolved and thin down with water.

ROLLING LAMP

Three holes may be drilled in the base of the floor-lamp, as shown in the illustration, and three casters inserted. This will provide a lamp which can be easily moved at will, with very little effort, and will not have to be lifted. This scheme is particularly useful when applied to exceptionally heavy floor-lamps. If the stems of the casters project above the base, they may be easily cut down with a hack-saw. — Sidney Lang.



SPARK PLUG CONNECTOR

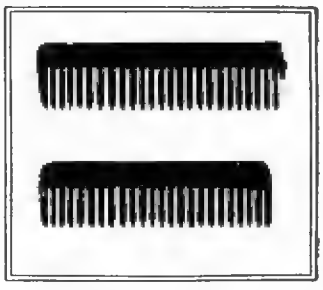
Many "B" batteries are provided with Fahnestock clips. These clips are very useful and one excellent service to which they may be put is illustrated at the left. The wires may be removed without using pliers. — Joe Kulyk.

PREVENTING SPLIT HANDLES

Any pipe fitting with internal threads may be screwed over the end of screw-driver or chisel handle and cut off so as to leave the ring shown. —H. L. Ketcham.

REPAIRED COMB

Many times a comb is broken, leaving a jagged, unsightly edge. This condition can be easily eliminated by filing down the jagged portion and finishing with fine sandpaper. — Sidney Lang.



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Readers Forum

SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them, whether caustic or not. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words or less, and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.

YES IT IS!

Editor, SCIENCE AND INVENTION:

Following are two statements from two different newspapers:

"The airplane is a miracle, because it scoffs at the law of gravitation. Incidentally, the real miracle will not be the flying machine that makes a non-stop flight of a week's duration, but one that will stand still in the air, even if only for an hour. (This discovery will cause unpleasant moments for Newton if he hears about it in the other world.")

"Some day we may gaze aloft and see an airplane suspended in the air, waiting for London and Paris to pass beneath."

To begin with, we are aware of (disregarding several minor motions) three principal motions with regard to our earth. First, our own "island universe" (which is one of the many that go to make up the whole universe) is moving towards the star Vega, at the rate of many thousands of miles per hour. Secondly, the earth is making a yearly voyage round the sun at the rate of about 70,000 miles per hour. Thirdly, the earth is revolving round its own axis at the rate of about 1,000 miles per hour. Now as the preceding quotations suggest, if we could go up in an airplane, stand still, let the world go by beneath, we would in effect be traveling at the speed of 1,000 miles per hour. That at first glance seems very logical; to do that, however, would require the nullification of gravity.

But can gravity be nullified? And supposing it could be, wouldn't it require great energy to do that, and isn't that apparently what the gasoline engine does at the present time? We know every body is carried along with the earth as it rotates; that this applies to every free molecule of gas on the earth's surface, to a heavy body, such as an airplane, immersed in a free moving gaseous medium as well in fact that neither matter or energy (light rays for example) can escape the power of gravity. Anything standing still in the air, or traveling in a small fixed circle, is not "letting the world roll by" beneath, but is being carried along with it at a speed of about 1,000 miles per hour, as well as when it pursues a definite course of direction.

In concluding, I might point to a recent prophesy by a Canadian aviation expert, that the day is not far distant when an airplane may travel at a velocity of 1,000 miles per hour. And when such a day comes, isn't that in effect accomplishing as much as is prophesied in the above quotations, only in a different manner?

JOHN HENRY MEREDITH,
New Haven, Conn.

(Gravity is being nullified to a very slight extent by the airplane. Anything which does not continue to fall down toward the center of the earth is naturally either nullifying or suspending gravity for the length of time that it is acting.

Of course, your reasoning is correct. The gravitational influence holds the molecules of gases comprising the earth's atmosphere close to the earth and for that reason an airplane would have to travel at a speed of 1,000 miles an hour or more in order to counteract the motion of the atmosphere. Of course, it was foolish for the newspaper to state that all a plane would have to do would be to remain stationary and let the earth pass beneath. From out in space that plane might be stationary with reference to the earth's axial motion, but actually, it would have to continue to travel at a speed equivalent to that of the peripheral rotation at the point where it rose.

Did you ever stop to consider that when gravitation is annulled over any spot on this earth, the effect will cause the atmosphere to rise upward and produce a terrific hurricane at the point where the gravity nullifier is in operation?—EDITOR.)

SPIRITUALISM AGAIN

Editor, SCIENCE AND INVENTION:

I have read your articles against false mediums with interest and sympathy, but my belief in a life after death is not disturbed. Take the statistical phenomenon, for example. If you assemble one hundred persons and inquire whether any of them have ever seen or heard a spirit, a percentage of them will answer yes, with mathematical certainty. If you then dismiss the first bunch as being subject to hallucinations and assemble another hundred, you will reach the same result, and you can search through the entire population of the United States or the whole world with the same average result. The thought may then occur to you that where there is much smoke, there possibly may be some fire.

Now take death-bed phenomena. Millions of dying persons have asserted the presence of spirit relatives. Were these dying persons all subject to illusions or was there one single clear-minded observer in the whole vast multitude? Now consider hypnotic phenomena. Scientists babble too much about hypnotic suggestion, and ignore other phenomena. Occult investigators have often asserted that a deeply hypnotized person can be made to travel in spirit to far places and bring back a report. Have the scientists carefully checked up this statement? The answer is they have not. Here is an opportunity for you to do some further investigating if you like.

JACOB LEVY,
Chicago, Ill.

AMAZING STORIES

IN OUR NOVEMBER ISSUE:

THE WORLD AT BAY, by B. and Geo. C. Wallis. (A Serial in Two Parts) Part I. Interplanetary stories always seem to please our readers. The application of the fourth dimension, in this story, enables the travelers to make the journey to the moon and back and around the earth in an astoundingly short time.

THE ANANIAS GLAND, by W. Alexander. What determines the extent of our truthfulness? It might very well be glandular action of some kind. Mr. Alexander has given us several unusual stories of psychological import, and in this very short story he cleverly works up an idea of extreme interest.

THE PSYCHOPHONIC NURSE, by David H. Keller, M.D. Instead of contenting himself with the conception of new mechanical labor-saving devices—generally involved in the human scheme of life—Dr. Keller always goes further. He gives us, in a perfectly natural manner, the ultimate psychological effect of his mechanical innovation or innovations, on the human being. Though he never destroys—or even temporarily puts out of commission—his newly developed apparatus, we are glad, when we finish the story, that we are still a little ahead of the invention.

THE EYE OF THE VULTURE, by Walter Kateley. It is an established fact by this time that the human eye is limited in its vision of the colors of the spectrum, just as the ear is limited in its range of sound appreciation. And just as the power of vision varies among people, so it must differ much more drastically from that of animals, birds, insects, etc. A bird, for instance, may not see all we do; on the other hand, many things within the bird's visual range, may be completely out of ours.

(We are not trying to argue against a possible belief in life after death. Religion is not entered into in the discussion of our spiritualistic investigations. You may believe in life after death and we may hold that there is no such thing. On the other hand, most of us adhere to the viewpoint that something must take place in this transition and something must happen to that illusive quantity called the soul. The body does not change in any respect whatsoever, yet the greatest minds, the greatest mental powers are blotted out when death takes possession of the body.

In accordance with the law of the conservation of energy, nothing can be lost and nothing gained; therefore, this mental power is not lost, but we no longer see it, we no longer feel its presence or notice its effects on the vast multitudes. Hence, we can rationally assume that this mental power goes somewhere, and for the sake of the argument, we might hold that it travels to another planet or to another state. Statistical calculations, when representative of a vast population, mean nothing. Had you assembled 100 people fifty years ago and asked them whether they thought they would ever be able to fly like a bird or run along the roads with horseless carriages, they would have laughed at you. Ninety-nine out of one hundred would have said "impossible." Those ninety-nine out of one hundred might have been suffering from hallucinations, and then again perhaps not. The fact that a vast maority believe they have seen a spirit does not mean to say that they have actually seen it. The mind plays peculiar tricks and if you close your eyes and only care to visualize a scene, you will see it in front of you rather strongly. You can increase the intensity or the brilliancy of such an image to such an extent that it will actually appear present. Such is the case in dreams and you have no doubt awakened on many an occasion and found it difficult indeed to believe that you were not dreaming.

Inasmuch as no one can define a spirit, it would be impossible for a person to say whether they had seen it or not. If a person can see a spirit, it can be photographed, and there is no conclusive proof that a spirit photograph has ever been taken. The camera will record things which even the human eye cannot perceive. Infrared and ultra-violet rays, invisible to the eye, can be photographed.

There is an old adage that where there is smoke, there possibly may be some fire. You have quoted this adage and inserted another probability—the word "possible." The fact that ninety-nine people out of one hundred smell smoke does not necessarily indicate that the fire is present. An examination would disclose this. The examination would have to be conducted by one who is experienced in locating fires. The same thing is true of spiritual phenomena.

True, there are millions of dying persons that have asserted the presence of spirit relatives, but this is no more than a dream. The mind travels very rapidly in a dream and either becomes futuristic or retrogrades back over the scenes of childhood. As a matter of fact, illusions frequently occur at the time of death which make the person dying act like a two-year-old, or a three-year-old child.

Appertaining to haunted houses, we would advise that every haunted house which has ever been investigated was found "not haunted." This in spite of the fact that thousands of people had visited them.

Concerning your hypnotic effect, we would say that this writer has personally conducted the experiment hundreds of times. Never on checking it up, has the experiment proven accurate. Of course, there were times where a fair amount of accuracy was obtained. It was for this reason that this writer was heartened to try further experimenting along this line. Subsequent results indicated that the average accuracies in comparison with the inaccuracies was very low, even less than that which would be obtained by ordinary guessing.

By all these statements we hope that we have not tried to change your idea of a life after death. Even though this is not definitely proven, the thought is beautiful to behold.—EDITOR.)

EARTH ONCE PART OF SUN?

Editor, SCIENCE AND INVENTION:

Do you think it possible that this earth we are living on today was at one time part of the crust that may have been on the sun?

I think perhaps it is possible. At the beginning of the solar universe I think this is what happened.

This is my idea of how this world came into existence.

After being cast off by the sun the world was thrown many millions of miles from the sun. As the sun's crust was covered by ice and water, this world took part of it along with it. A rotary motion was also imparted to the world. Now as we know that any body that will conduct electricity when rotated in an electrical field, a magnetic or attracting field is set up around it. So with the world, it is composed of elements of which the majority will conduct electricity. These elements being rotated in an electrically charged atmosphere, set up a magnetic field around themselves and thereby are attracted toward the center of its axis.

Perhaps millions, even thousands of years after the world was cast off it wandered around through space before it took up its orbit around the sun.

(*Continued on page* 653)

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Popular Television

Built and Described by the Staff

How To Build The S & I TELEVISION RECEIVER

A slight adjustment of the rheostats and the picture comes in clearly. This photo shows a complete television receiver connected to an ordinary radio set. The picture is seen in the cone.

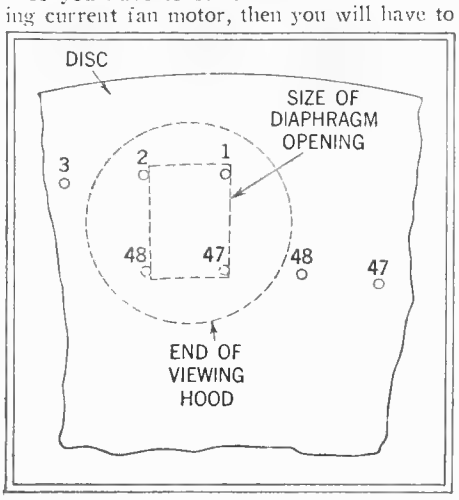
A Television Receiver of Simple Design, Built Around an Ordinary 16-inch Electric Fan Motor

THE front cover illustration shows the simple television receiver designed and built by the editorial staff. The accompanying photographs and drawings show the appearance and the construction details of the television receiver, the apparatus pictured having, of course, to be connected to the output of a suitable radio receiving set. The ideal set for receiving television images from WRNY or other stations, is, for the broadcast wavelength of 326 meters, one comprising two or three stages of tuned radio frequency, a detector and at least three stages of resistance-coupled amplification. When a resistance-coupled amplifier is used, it will be found best to use about 250 volts at least on the last stage from either storage or dry "B" batteries. A good "B" eliminator may be used, but a special filter is usually necessary, to prevent "motor-boating" with a resistance-coupled amplifier.

PROPER MOTOR FIRST ESSENTIAL

THE first requisite for building this television receiver is a good 16-inch fan motor. If the television disc to be used (it should have 48 holes for reception from WRNY and 3XK; also 1XAY and WLEX of Boston; and 24 holes for reception from WGY, 2XAD, and 2XAF, G. E. Co., Schenectady), is quite light, a 12-inch fan motor may do the work. If you have direct current in your laboratory or other location where the apparatus is to be operated, then you will have no trouble in controlling the speed of the motor down to the 450 r.p.m. required for WRNY reception or the 900 r.p.m. required for reception from the other stations broadcasting television.

If you have to select or use an alternating current fan motor, then you will have to find out whether the motor can be slowed down to a steady speed of 450 r.p.m. If the A.C. motor happens to be of the type that has throw-out contact brushes, which open the starting winding after the motor has attained fairly high speed, you will probably find this sort of motor unfit for television purposes. If the motor is of the universal A.C.-D.C. type, with commutator and brushes, the armature being connected in series with the field, then you will find that this motor can be regulated as to speed very nicely by means of the series resistances shown in the accompany diagram. We strongly recommend a universal type motor if you are going to purchase one, as these have been found to regulate well with regard to the speed.



The method of laying out the diaphragm opening is shown clearly by the above drawing.

MOUNTING THE DISC

THE disc used in the television receiver here illustrated was a 48-hole 16-inch diameter bakelite disc of standard manufacture. This disc may be mounted and secured on a regular bushing provided with lock nuts supplied by the people who make the disc. In the present case, however, the perforated disc was mounted on the brass spider and hub which had originally carried the fan blades. The blades were removed from the legs of the spider and these were then flattened out in a vise and checked up on a lathe for alignment. A light cut may be taken across the face of the spider legs in the lathe, if one is handy. By drilling holes through the bakelite disc, it is readily secured to the spider by machine

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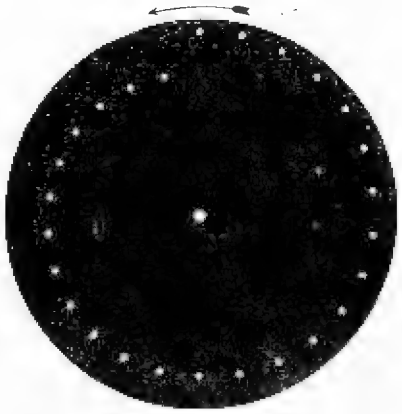
screws and nuts, or the holes in the spider legs may be tapped if the builder so desires. Care must be taken to see that the disc rotates as perfectly as possible in both planes of rotation, that is, flatwise and edgewise; in other words, it must not wobble and care must be taken to see that the spiral is rotated in a true manner. These two requisites are easily checked up by means of a machinist's surface gauge, or else by making up a gauge from a nail driven in a block of wood and holding this near the disc as it is slowly rotated by hand.

NEON TUBE MOUNTING

THE frame for supporting the neon tube behind the revolving television disc is simply constructed from light brass bar, measuring about 1/16-inch by 5/8-inch. Strap iron may be used if the builder happens to have this stock on hand. No dimensions are given for the height of the frame as many builders will want to use a different size disc than the one we used, and so the height of the frame and the dimensions of the metal composing it will depend upon the diameter of the disc, of course.

Examination of the drawings herewith will show that the neon lamp may be rotated, so that the front plate inside the tube may be placed exactly parallel with the perforated television disc. This is easily accomplished by the simple expedient of using a standard vacuum tube socket having a hole in the center, or what is known as the one-hole mount. By passing a machine screw through the center of the socket and putting a nut on top of the bakelite shelf, the socket and neon tube can be rotated as required. Two sub-base brackets or supports, available at any radio supply store, are used in building the top of the superstructure which carries the neon tube. Two well insulated wires lead from the vacuum tube socket down to the base of the machine. The connections to the socket for the average neon tube is to the plate terminal and to the diagonally opposite filament terminal. This can be determined by experiment after the machine is built, or else beforehand by testing the neon tube on your receiving set. The plate that faces the television disc is the one that has to be illuminated. In some neon tubes there is a large and small plate; the large square plate is the one that is to face the television disc.



This indicates the arrangement of the holes and the direction in which the disc should rotate to receive television from station WRNY.

HINTS ON RECEPTION

WITH regard to the style of motor to use this is best of the series type; that is, with the armature and field winding connected in series. Small induction motors can be used, but do not regulate well in speed much below one-half their normal speed of 1750 r.p.m. If the picture image is observed and drifts toward the right, the motor is going too slow; if the picture drifts to the left, it is going too fast. The editor has found it advisable to regulate the motor speed to a point considerably above the desired value, and then to apply a piece of cardboard or a blotter against the surface of the disc to slow down the speed to the desired point. D.C. motors will regulate very well with the electrical rheostat arrangements shown in the circuit accompanying this article, however.

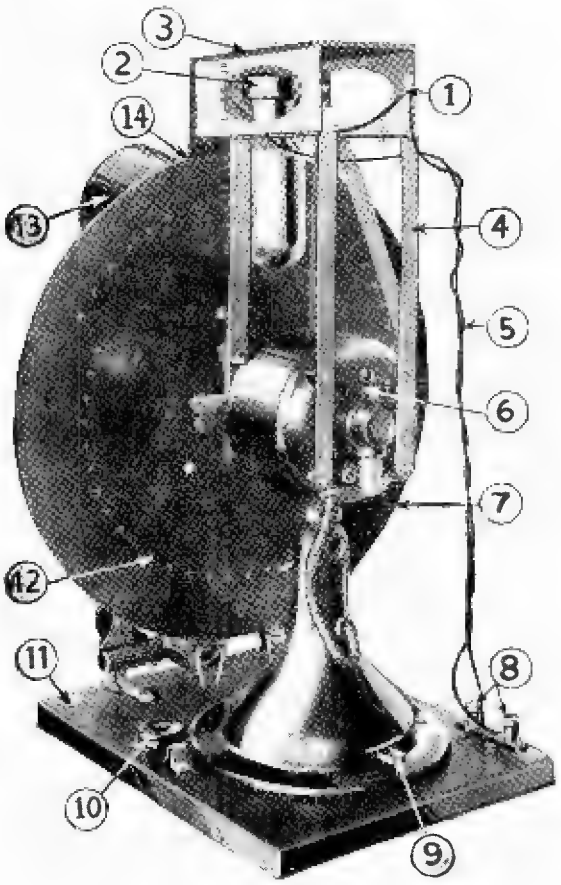
VIEWING HOOD AND LENS

THE viewing hood or visor shown on the machine herewith was built by cutting down a standard megaphone which can be purchased in any sporting goods store. The heavy metal ring at the mouth of the megaphone enabled the designers to secure it by means of three spring brass clips, soldered to the brass front plate shown in the drawings. It can be snapped off whenever desired. One of the accompanying drawings shows how the size of the diaphragm plate is determined, the rule here being that only one disc hole or perforation must be exposed at a time. A thin piece of leaf copper was used in the present case, from which to cut the diaphragm opening, and this was sweated to the brass front plate of the instrument. A fairly strong lens, about 2 inches in diameter, with a focal length of approximately 3½ inches, was procured for the purpose of helping to enlarge the image. This lens was secured inside the megaphone viewing hood by placing three machine screws through the megaphone shell and putting nuts on these, inside the shell. This is probably one of the best ways to build the viewing visor for any size television receiver, as the visor can always be snapped off the machine when it is to be moved to some other location.

STROBOSCOPE INDICATES CORRECT SPEED

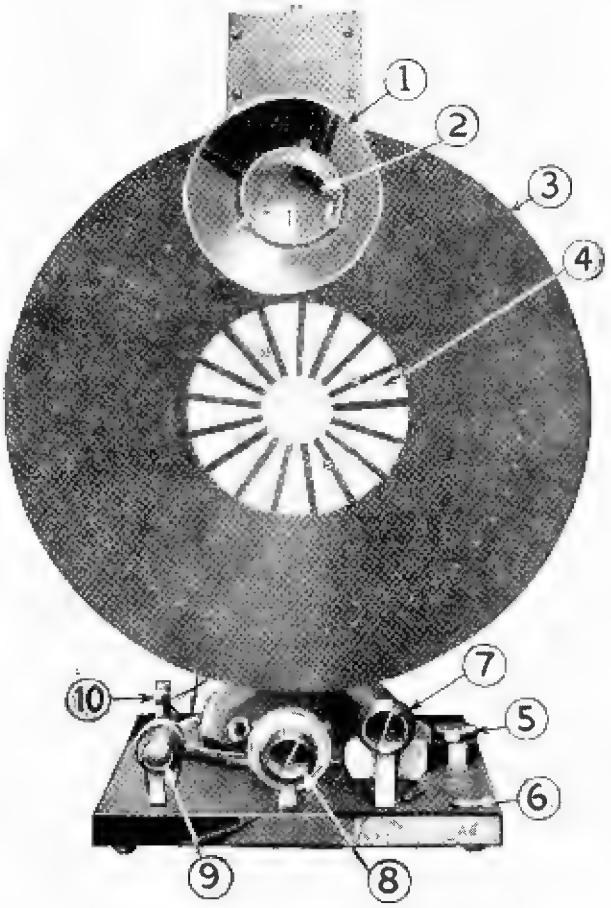
ONE of the greatest problems the beginner in television reception will encounter is that of checking the correct speed. Of course the average machinist or electrician will not mind checking the speed frequently with an ordinary speed counter, or possibly he may be so fortunate as to own a tachometer for the purpose. However, the average tachometer cannot be used with a small motor, as it takes too much power from the motor, and therefore slows the disc down and you do not know where you are at.

The method of using the *stroboscope* principle, with the black line disc noted on the front cover and in the present photographs,



In the diagram at the left, 1 indicates a separation of the wires leading to the socket 2, affixed to top plate 3, which in turn is mounted on the uprights 4, screwed fast to the motor by the screws which hold the case in place. The wires 5, lead down to binding posts 8, which connect with the ordinary receiving set. 9 is the standard switch on the fan motor which receives its current through plug 10. 11 is a control button, 12 the holes in the television disc, and 13, the cone.

Right: 1 indicates the cone; 2, the lens; 3, the disc; and 4, the stroboscopic pattern; 5, attachment plug; 6, control button; 7, vernier rheostat; 8, main motor control; 9, neon lamp control; and 10, leads to the receiving set.



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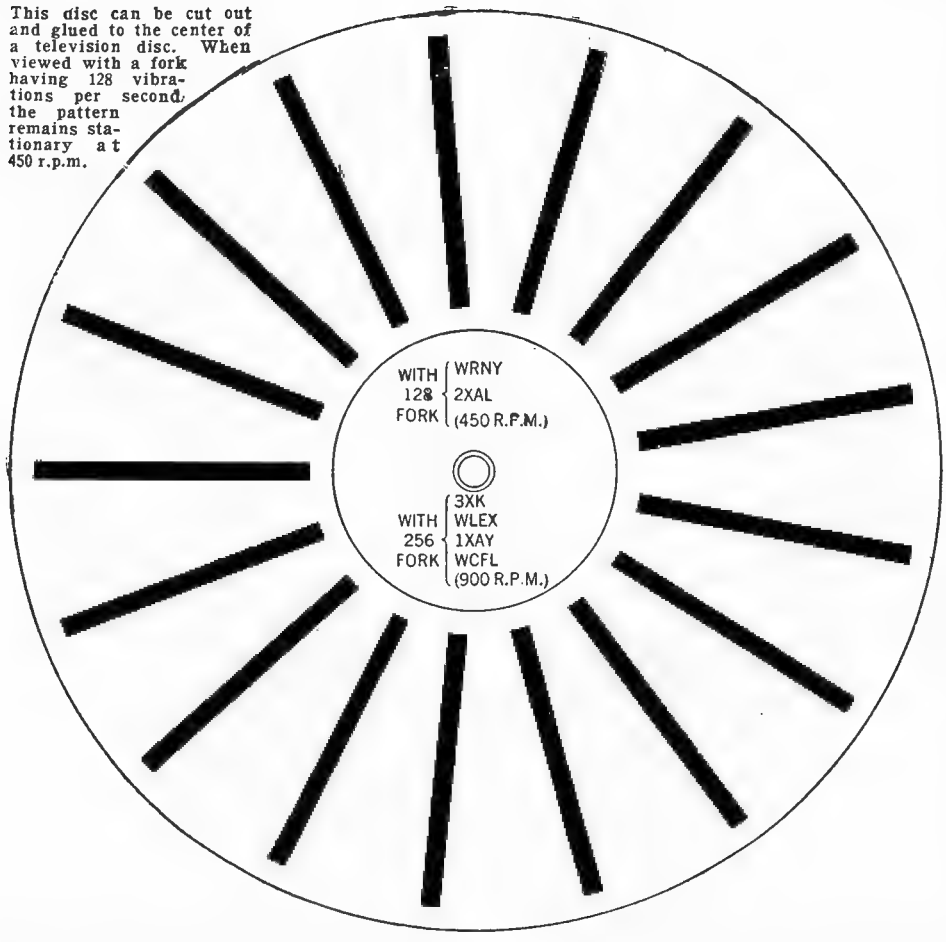


This disc can be cut out and glued to the center of a television disc. When viewed with a fork having 128 vibrations per second, the pattern remains stationary at 450 r.p.m.

together with a tuning fork of the proper pitch, was suggested by the Editor, Mr. H. Gernsback, and details were worked out by members of the staff.

For the benefit of those who are desirous of using the stroboscope principle for checking other speeds than those here given, the following table and formulae will be found useful.

STROBOSCOPE TABLE

R.P.M. of Shaft	*R. P. Sec.*	*Tuning fork frequency*	*No. of marks on chart*
60	1	128	128
120	2	128	64
180	3	128	42.6
240	4	128	32
450	7.5	128	17
480	8	128	16
900	15	256	17
1080	18	128 (72)	7.1 (4)
1260	21	128	6

These formulae will help to solve your problems: here N = Rev. per second of disc; F= freq. of fork per sec.; and M = number marks on disc. Then N = F ÷ M; M = F ÷ N; and F = M × N.

The following pitch forks are available: 426.6, 256, 128, 288, 320, 341.3, 384, 480, 512.

For the benefit of the constructor we have provided herewith a good size reproduction of the stroboscope discs which can be cut out or else copied on to a piece of Bristol-board or drawing paper, and either glued or attached to the front of the television receiver. A tuning fork of the proper pitch may be obtained from music stores or from college laboratory supply houses, names of which will be furnished upon request from the editor.

For checking the speed of the motor at 450 r.p.m., a tuning fork giving 256 vibrations per second is necessary. This is used with a disc containing 17 black marks for the 450 r.p.m. specified. For other speeds, either a different fork has to be used, or else the number of lines on the stroboscope disc will have to be changed. All this data is contained on the drawings of the discs reproduced herewith.

All one has to do in using the stroboscope check for the proper speed, is to regulate the rheostats in series with the motor, and then repeatedly take a sight on the revolving black line disc through the legs of the vibrating tuning fork. The tuning fork is struck on the edge of the table or across the knee, and while vibrating, it is held a few inches from the eyes and twisted, so that the revolving disc is observed in a diagonal line passing under the corner of the upper fork leg and over the corner of the lower fork leg. This line of sight is shown in one of the accompanying diagrams.

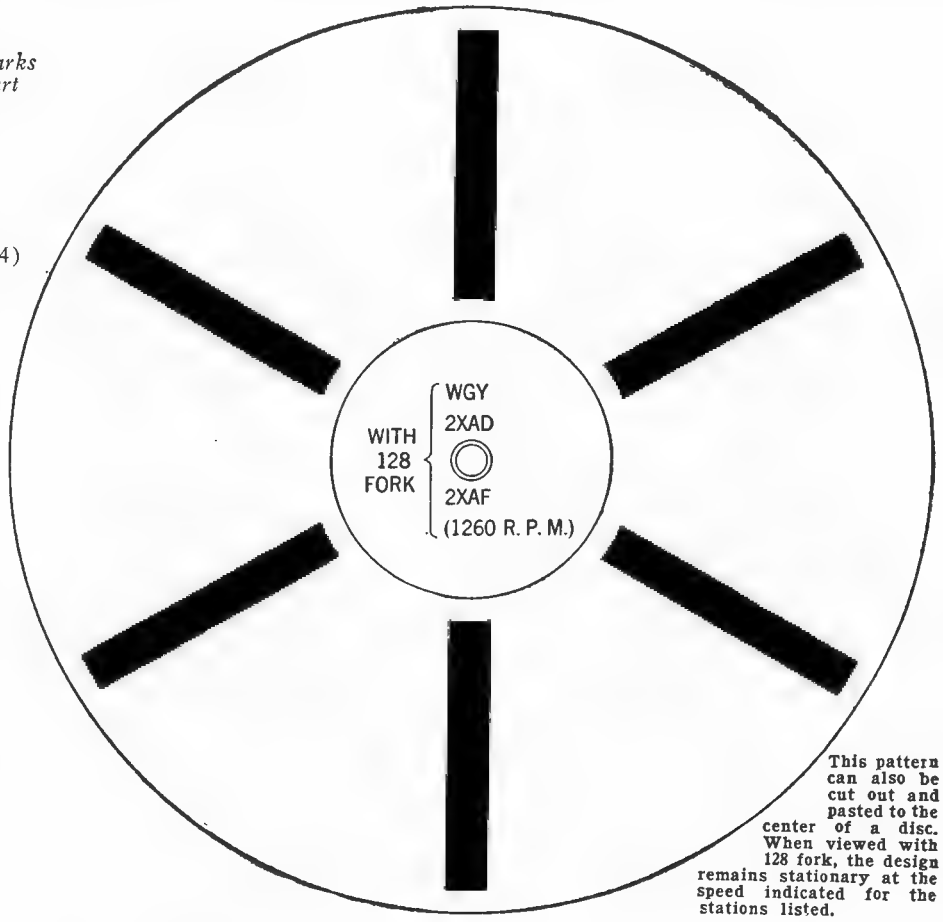
While in most cases it will probably be found that the number of marks on the disc or else the vibrations of the tuning fork to be used will come out to an even figure, or at least that a suitable combination can be worked out for the speed desired, the calculation may show that an uneven number of marks will be required with any standard fork. Here, instead of using a number of radial black marks on the rotating disc, a spiral may be used and with this sort of design, any uneven number of convolutions such as 7½, 7-1/3, etc., may be employed.

HOOK-UP OF APPARATUS

ONE of the accompanying diagrams shows how the power clarostat (about 150 ohms maximum resistance) and the small 10 to 15 ohm variable resistance is connected in series with the motor. Across the small variable resistance a push-button is connected, and by pushing this button periodically, it becomes possible to keep the motor speed quite constant. In setting the speed of the motor in the first place, the rheostats are adjusted until the speed is a little below the 450 r.p.m. (if you happen to be "looking in" at WRNY's television signal), this factor being indicated when checking the speed with the stroboscope fork, by the fact that the black lines on the disc are seen to rotate slowly backward. If these lines rotate slowly forward or left-handed, then the speed of the motor and disc is above 450.

Rubber-covered wire or lamp cord may be used to connect the rheostats and the motor. The small clarostat at the extreme left of the motor baseboard is connected in series with the wires supplying the energy

(*Continued on page 632*)



This pattern can also be cut out and pasted to the center of a disc. When viewed with 128 fork, the design remains stationary at the speed indicated for the stations listed.

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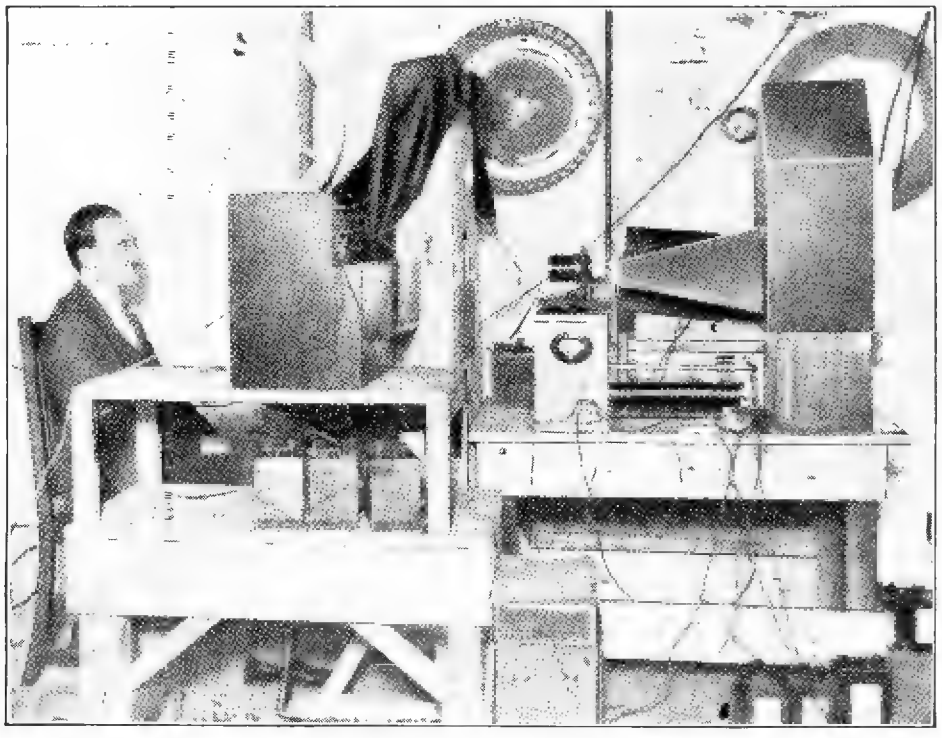
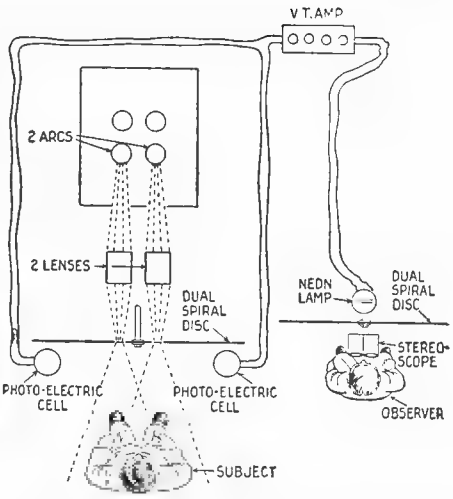
STEREOSCOPIC TELEVISION

Three-Dimension Images Now Obtainable

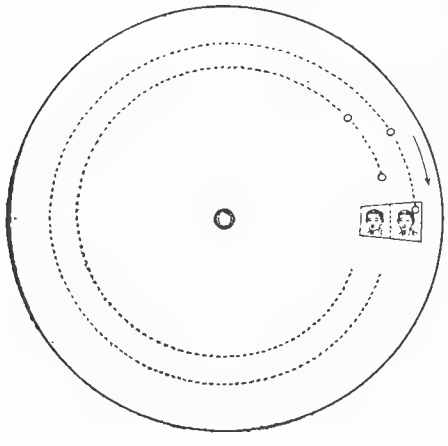


The illustration above shows the transmitter used for the production of stereoscopic images.

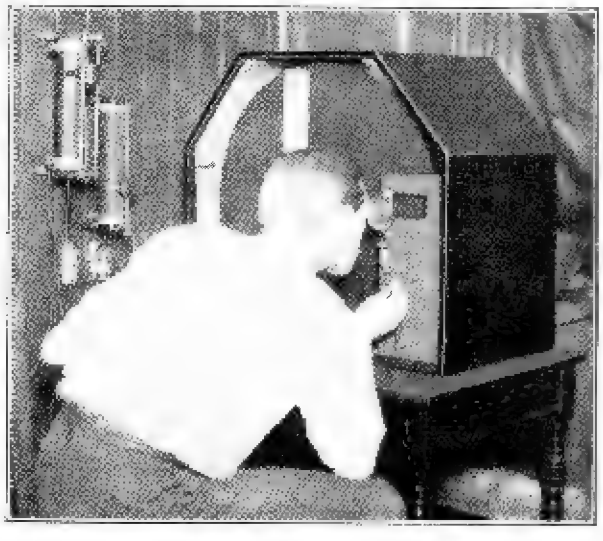


The above drawing shows in simple form the principle employed in the new television apparatus.

TELEVISION is progressing so rapidly that difficulty is experienced in keeping up with the new advances which are now announced almost daily. Radio movies and colored television were two of the big steps forward, and now comes the third, stereoscopic images. At the transmitting end of the system, two arc lights cast their beams through two lenses which concentrate the light and direct it through two separate spirals of holes. The holes in this disc are arranged alternately as illustrated and the subject is scanned from two slightly different angles, so that a three-dimension effect is obtained at the receiving end. A photo-electric cell arranged on either side of the subject, picks up the light impulses and changes them into electric pulsations. These are then amplified and broadcast in the usual manner. At the receiving end the usual neon lamp is used, in front of which rotates a spiral disc similar to that used at the transmitter. Two images are built up and when viewed through a stereoscope stand out in relief. The double spiral disc may be seen in the large photograph hanging on the wall. The two sets of holes are clearly seen. Unless the picture received is very small, it will be necessary for larger images to use a bigger neon lamp, that is, one having a larger sized cathode. In the future may we expect a combination of the three latest advances giving us three-dimension colored radio movies?



At the left is a drawing showing the construction of the scanning disc which is fitted with two spirals of holes.



The photograph at the right shows a view of the receiver with the operator viewing the images through a stereoscope.

TELEVISION TIMETABLE

Station	W. L. Meters	Disc Holes	Disc R.P.M.	Speed Pictures Per Sec.	Time
WRNY—New York City	326	48	450	7.5	Every hour on hour when station is on air.
2XAL	30.91	Same as WRNY			
WGY—Schenectady	379.5	24	1260	21	Tues., Thurs., Fri.—12:30-1 P. M.
2XAD	21.96	Same	Same	Same	Tues.—10:30-11 P. M. (WGY and 2XAF)
2XAF	31.4				Sun.—9:15-9:30 (WGY and 2XAD) E. S. T.
3XK—Washington, D. C.	46.7 186	48	900	15	Mon., Wed., Fri.—8-9 P. M. E. S. T., Radio Movies
1XAY—Lexington, Mass.	51-62	48	900	15	No Regular Schedule
8XAV—Pittsburgh, Pa.	62.5	60	960	16	No Regular Schedule
4XA—Memphis	120-125	24	900	15	No Regular Schedule
9XAA—Chicago	62.5	48	900	15	Mon., Wed., Thur., Fri.—9-10 A. M. C. S. T.
6XC—Los Angeles	65.22-66.67	36	1080	18	Will Start Sept. 15th. Daily—10:30-11:30 P. M. P. S. T.
WLEX—Boston	62.5	48	900	15	
WCFL—Chicago	61.5	45	900	15	

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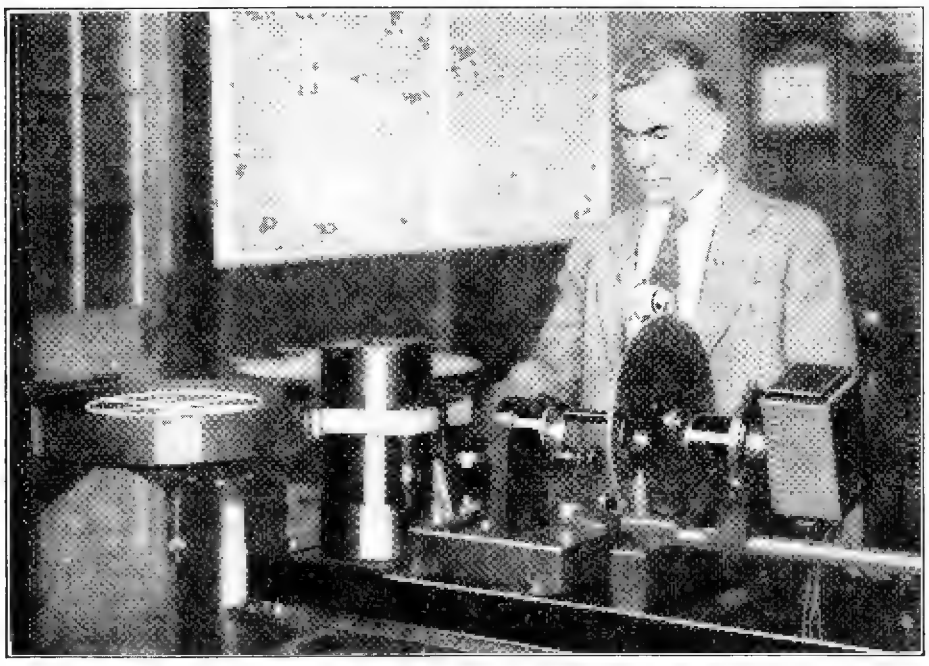
Radio Movies Demonstrated

Motion Pictures Sent Via the Ether by New Television System



The transmitter used by the Westinghouse engineers for the radio moving pictures is shown in the above photograph. Note the film passing before the scanning disc. Each picture is scanned at the rate of sixty times each one-sixteenth of a second.

LEADERS in radio recently met at the famous Westinghouse plant to review the laboratory progress of what the layman might term imminent miracles of sight and sound transmission. The meeting was one of the most important in radio annals, since such work as television, facsimile radio, power tubes, photophone and broadcast motion pictures was not only reviewed but future progress in these lines definitely mapped. Of these developments, the photophone is the only one in which perfection has been attained, at present. The others are in various stages of development, ranging from the near perfection to embryonic laboratory experiments.

The most striking of all radio developments reviewed was the broadcasting of *motion pictures* which, transmitted on radio waves, were picked up on a receiver located in the television laboratory and reproduced before those assembled there.

It was the first demonstration of radio movies by this particular system, and possibly the most interesting of the many advances in the science of radio announced in the past year.

While radio movies are still in the laboratory stage, Mr. H. P. Davis, under whose auspices the demonstration was made, states that the event heralds the time when the radio listener will sit at home and have that most popular form of entertainment, motion pictures, projected by his own individual radio receiver.

The development of radio movies is a triumph of scientific engineering. Barely two months ago, the idea came to the mind of Dr. Frank Conrad, in charge of this branch of his company's activities, and the fact that he has brought the device to the laboratory stage in the degree of perfection witnessed a few weeks ago, is said to have set a record.

Radio movies are a step beyond previous developments in television and required the invention of a number of appliances in addition to a great deal of scientific calculation, synchronism of various high-speed mechanisms, and accurate control of light and radio waves.

GENERAL PRINCIPLES

ALTHOUGH the sending of moving pictures by radio, as may well be imagined, required many complicated and delicate pieces of apparatus, the principles of the art are not beyond ordinary comprehension.

Photography in its simplest form consists of the reproducing of spots of light and shadow in the same arrangement as they appear in the subject photographed. The screening of a motion picture, of course, requires that a roll of film be operated at a speed which sends sixteen pictures a second before a projecting beam of light. Because of the structure of the human eye, if a series of pictures follow each other at the rate of 16 or more per second, the human eye sees it as a single moving picture. (*Editor's Note: At a slower speed than 16 pictures per second, a fair picture is reproduced, accompanied by a certain amount of flicker. WRNY is using now about 7½ pictures per second, and favorable reports of successful reception have been received.*)

MOVIES PLUS RADIO

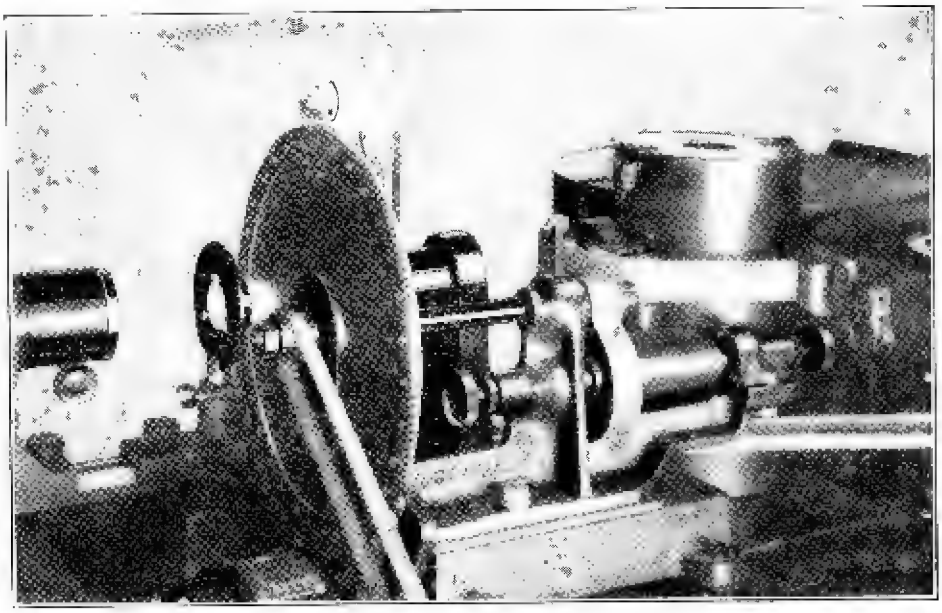
ALL this the broadcasting of radio movies requires, with the addition that the spots of light must be transformed into frequencies, some of which are in the audible range, transferred to a radio wave and broadcast as electrical energy. In receiving the pictures, the process is reversed, the electrical energy is picked up, and the frequencies returned to lights and shadows, which when viewed presents the radio movie.

In the first step of the process a pencil of light traverses each picture, or *frame*, as it is called, at the rate of 60 times each sixteenth of a second. This process produces a 60-line picture, as clear as the usual newspaper halftone illustration.

EACH PICTURE SCANNED

THE pencil of light is produced by a scanner, which is a disc with a series of minute *square holes* near its rim. The disc is so arranged that all light is excluded from the film except that which goes through the square holes. The disc turns very fast, and as it turns passes the beam of light across each *frame*, with the result that an individual beam of light touches every part of the *frame*.

The beam of light passing through the film falls upon an electric eye or photo-electric cell, which is not unlike an oversized incandescent lamp. Within the cell, however, is a metal whose electrical resistance varies with the light falling on it. Caesium, a rare metal, is used in the Westinghouse cell. The amount of light falling on this cell determines the amount of current passing through it. The result is that each individual beam of light sends an electrical impulse which varies directly accord-



Above is a close-up view of the radio movie transmitter shown at the top of the page. The scanning disc has a series of minute square holes. As the disc turns, the beam of light passes across each frame.

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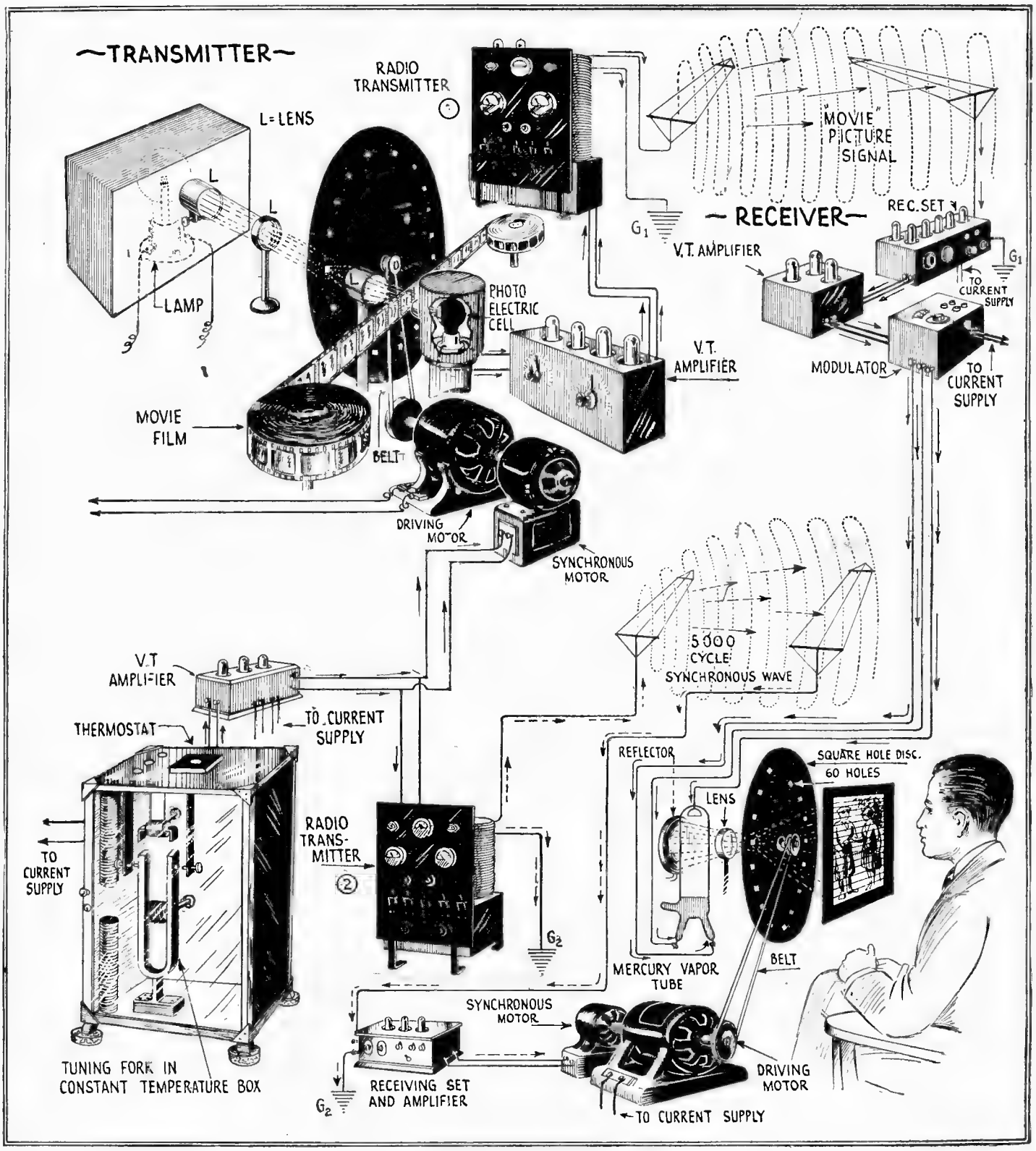

The above illustration shows in detail the apparatus employed in the projection of motion pictures by radio. In the demonstration described here, the signals were sent a distance of about four miles, that is, two miles from the laboratory to the transmitter by wire, and two miles back to the laboratory by ether waves. The lower part of the picture shows the main elements of the 5,000 cycle synchronizing circuit.

ing to the amount of light or shade in the film through which it passed.

LIGHT BEAMS BECOME RADIO WAVES

THE beams of light have now become electrical impulses and are sent on to the broadcasting station. Here the beams assume definite and varied frequencies, some of which are audible. Dr. Conrad states that these frequencies range from somewhere near 500 to approximately 60,000. Since the human ear is limited to frequencies of approximately 15,000, much of the radio movie wave is inaudible.

At the broadcasting station these frequencies are super-imposed on a radio wave and transmitted exactly as the ordinary music or voice. The radio signals can now be sent across a room, or across the continent. Their distance range is limited only by the broadcasting station's equipment (power).

In the demonstration here described, the signals traversed a distance of about four miles; two miles from the laboratory to the broadcasting station by wire and two miles back to the laboratory by radio.

To turn these radio waves back into light, an arrangement which permits the use of a *mercury arc lamp* is used. By this adaptation the weak radio currents control the action of the many times more powerful current operating the arc lamp. This action may be compared to the action of a radio tube, where the weak radio current on the grid of the tube controls the action

(*Continued on page 666*)

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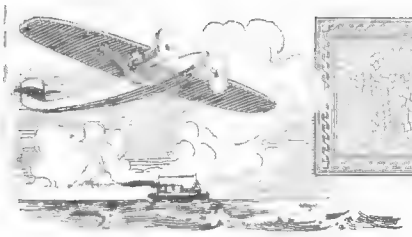
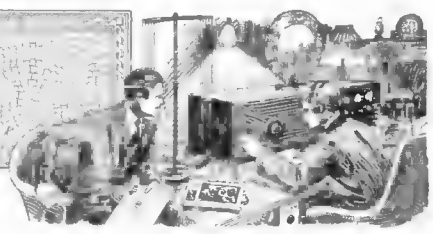


Radio



Plane Broadcasts Radio Photo

Lindbergh's Picture Received on Rayfoto Recorder

The unretouched picture as received at WFI is shown above.

ABOUT the middle of August of this year a photograph of Col. Lindbergh was successfully transmitted from a Fairchild cabin monoplane and received at WFI, Philadelphia. The transmission was not entirely successful, however, due to the failure of the airplane generator. The erratic operation of this generator resulted in the reception of a marred picture. The Ludington Philadelphia Flying Service, Inc., state that they are going to continue working along these lines with the intention of perfecting the system. It is said that about 120 homes in Philadelphia were equipped with the Cooley Rayfoto recorders required for the reception of the airplane's signals.

The transmitter was tuned to 53.3 meters and used the call letters 3XB. The transmitter was a 75-watt special short-wave radio telephone outfit constructed especially for the purpose. Ordinarily the transmission of photographs by the Cooley system involves the use of a powerful source of light, a photo-electric cell, a high-gain amplifier, etc. This apparatus was eliminated in this test by using it to record Lindbergh's photograph on a phonograph record. The phonograph record was then used in the airplane to vibrate the needle of an electric pick-up device identical or very similar to the electromagnetic pick-ups used with the modern electric phonographs. The transmitted signal consists of a 53.3 meter wave, modulated at 800 cycles per second, the amplitude of each one of these electrical vibrations which are sent out 800 times a second, is proportional to the amount of light reflected by one of the 38,400 small areas into which the photograph to be transmitted is divided by the "convertor" mechanism which, of course, does its work on the ground and not in the airplane.

The work involved in receiving the picture was undertaken by W. P. Asten, receiving engineer of the Radiovision Corporation. The picture at the bottom of the page shows Mr. Asten placing the sensitized paper on the drum of the printer unit. The movement of this drum must be in synchronism with the revolving phonograph record in the airplane; this speed is maintained by a synchronizing impulse which is recorded on the phonograph record, which impulse is received and actuates a relay at fraction of a second intervals. The relay action is such that when the recording drum moves too far in a given time, due to an increase of its speed above synchronous speed, it is held motionless by the relay just long enough so that when released it will again be in step with the phonograph record. The sensitized paper is exposed to a small spray of blue sparks emitted from a needle point, under which the entire surface of the photographic recording paper is moved by the drum. This spray of blue sparks is the corona discharge supplied by a radio frequency vacuum tube oscillator. After the transmission is completed, the sensitized paper is removed from the drum and developed and fixed in the ordinary manner. The results of these tests indicate that high-grade reproductions of photographs can be transmitted from airplanes in flight to a receiving station within five or ten miles. The range, of course, may readily be increased to considerably greater distances than this by using greater power. It took approximately three minutes to transmit this picture, and this can be considerably reduced by developing the apparatus, particularly by improving the printer unit.

The experiment was

(Cont. on page 668)

Above is a view of the airplane cabin and the phonograph record of the photo.

The apparatus above received Lindbergh's picture. The loud speaker was used for tuning the receiving apparatus to the wavelength of the airplane transmitter.

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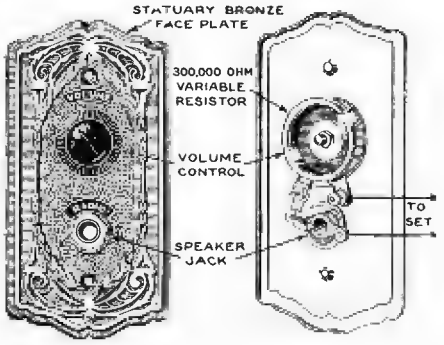
NEW RADIO DEVICES

Accessories Recently Developed Which Will Be of Value with Any Radio Set

RADIO OUTLET

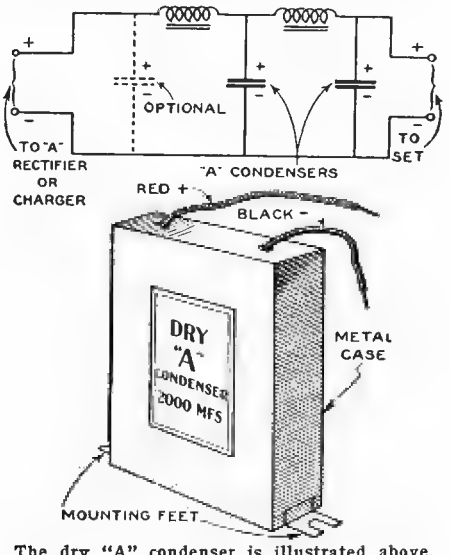


Above is a view of the new radio outlet which is furnished with an attractive face plate. Volume can be controlled with the variable resistor. Connections to the set are made as shown.

RADIO is rapidly taking a more important part in our homes, and in view of this fact a Chicago manufacturer is now making a number of radio receptacles furnished both in statuary bronze and brass. One of the former is illustrated here and is a combined volume control and speaker jack. The plate will fit a standard outlet box, or it can be secured in any convenient manner. The volume control is a three hundred thousand ohm variable resistor placed in series with the speaker jack, one end of the volume control and one end of the jack being connected to the receiver. By means of this arrangement, it is possible to control the volume at one speaker without effecting the volume of any other speaker in the circuit.

"A" CONDENSER

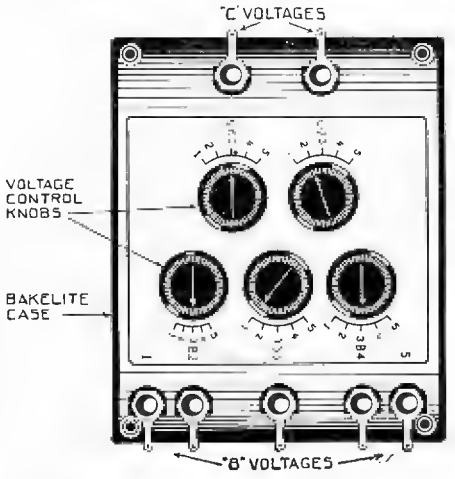
IN order to meet the increasing demand for a low voltage high capacity condenser suitable for use in the filter circuit of an "A" battery eliminator, a Brooklyn manufacturer has now made available an "A" power condenser. Three types are being made at present, having capacities of 1,500, 2,000 and 4,000 microfarads. When used with a good tube battery charger, or dry rectifier, the filter condenser will effectively smooth the output when using the two small choke coils, having an inductance of about ½-henry each. The "A" condensers are placed in heavy metal cases and are provided with suitable mounting feet.



The dry "A" condenser is illustrated above, and is used in the circuit as shown in the schematic diagram.

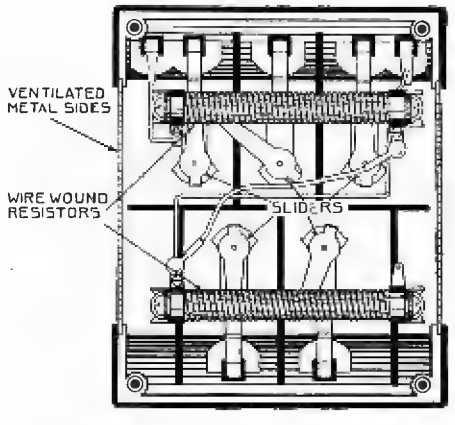
VOLTAGE DIVIDER

A NEW voltage divider built entirely in one unit and housed in a bakelite case, is now being made by a New York radio manufacturer. By simply connecting the output terminals of the filter of the eliminator to this unit, the proper plate and grid voltages can be obtained. Two wire wound resistors with five variable taps provide flexibility to all receiver current conditions. The divider can be mounted in any desired position and because of its neat appearance, it lends itself to mounting on the front panel of the eliminator. The flexibility of an



Above is a top view of the new voltage divider to be used with "B" eliminators.

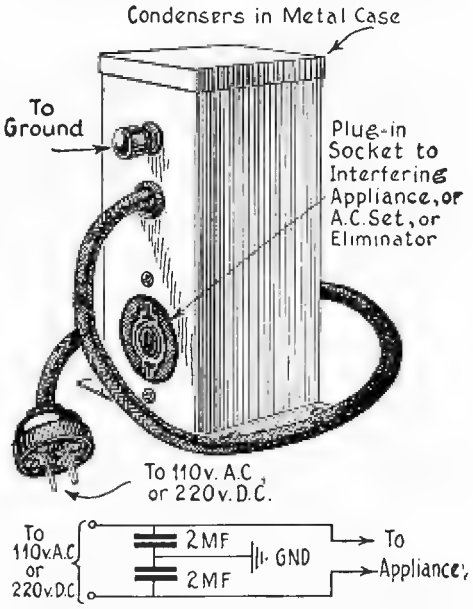
eliminator is governed largely by the resistance network used. By making the resistance units variable, it is possible to obtain the exact voltage requirements of any receiver. A novel feature is the fact that all the control knobs are calibrated, and a chart is provided which shows the exact setting for each knob to supply various voltages for



The internal construction of the divider may be seen above. Two wire-wound resistors are used, with suitable sliders, for varying the voltages.

any receiver from four to eight tubes. Information is also given for setting the knobs to meet unusual voltage requirements. Thus the necessity for an expensive high resistance voltmeter is done away with. Adequate ventilation is obtained through two perforated metal sides. The divider is easily installed by making two connections to the filter of the eliminator. All binding posts are marked for the constructor's convenience.

INTERFERENCE FILTER

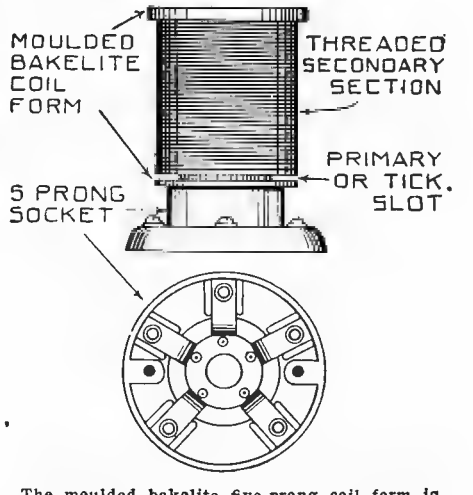


The interference filter and circuit diagram of connections are illustrated above.

AN eastern radio concern has designed an interference filter for preventing noises from the power line from interfering with the operation of electric receivers or power supply devices. This filter may also be used to prevent radiation and interference from oil burners, electric sewing machines, and all similar electric appliances. Two types are available, one which can be used with a maximum voltage of 220 volts A.C., or 400 volts D.C.; and the other designed for operation with 125 volts A.C. or 200 volts D.C., illustrated here. This filter consists of two 2 mfd. in series with mid-point grounded as shown.

COIL FORM

A CHICAGO manufacturer has recently brought out a moulded coil form equipped with a five-prong base fitting a standard UY type socket. The secondary winding space is threaded in the broadcast coil forms, and smooth in short-wave forms. At the bottom of each form is a tickler slot, which also may be used for the primary, or if desired the primary may be placed within the secondary.



The moulded bakelite five-prong coil form is illustrated above. These are available with either threaded or smooth winding spaces.

(Names of manufacturers furnished upon request)

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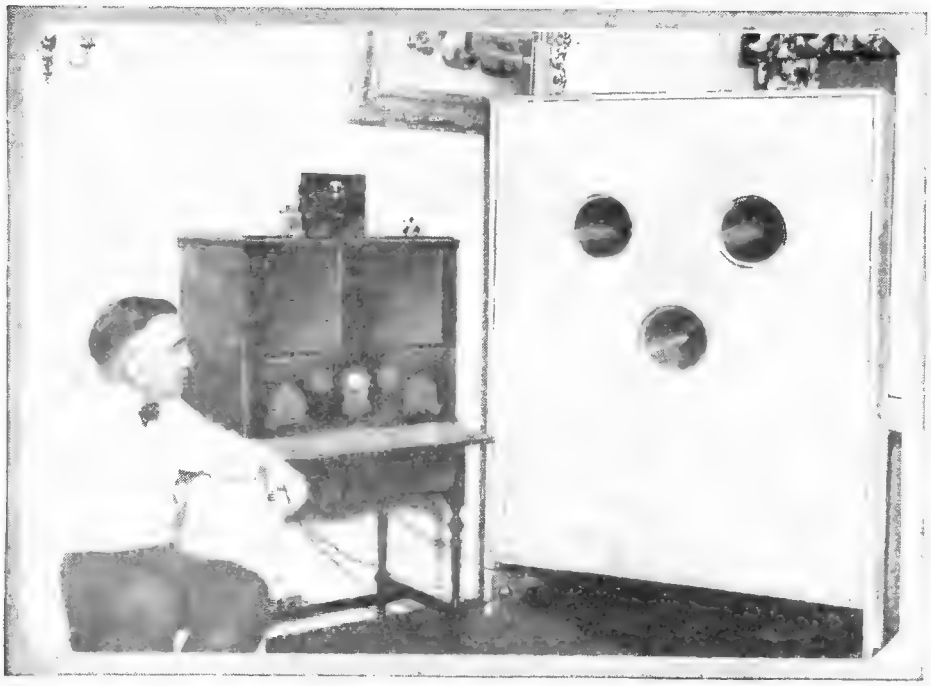
The Latest in Speakers



The above photograph shows Mr. O. Mampe, of Palisade, New Jersey, whose home is most elaborately equipped with radio apparatus of the latest design. One of the most novel features is a huge baffle board used with three electrodynamic speakers. It measures 5½ ft. in height and is 4½ ft. wide. The baffle is made of wood ⅞ in. thick and assists in lifelike reproduction.

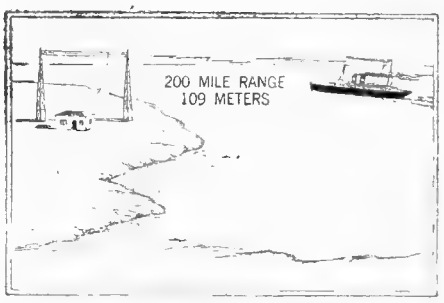
A rear view of the elaborate reproducing equipment is shown above. The speakers are mounted upon shelves with the power amplifier and the eliminator placed at the bottom. It is important to have the input to each speaker in phase, otherwise the radiation in each individual unit would interfere.

Mid-Ocean Radiophones

The above photograph shows Ronald Colbert, radio operator of the "S.S. Avalon," using the radio telephone, by means of which passengers on the ship can be paged from the docks of the Wilmington Transportation Company. The photo at the right shows the interior of the radio room on board the tugboat "David P. Fleming," with the captain calling the office for orders. The transmitting equipment used has a range of 200 miles.

Mr. R. D. Lemert, a Los Angeles engineer, has perfected a radio telephone system which is particularly adapted for communication from ship to shore. It is now being used on all the vessels of the Wilmington Transportation Co. of Los Angeles, California. It is as convenient and as practical as a telephone between the office and the home, and has recently been installed on eight seagoing tugboats and on the "S.S. Avalon" and "S.S. Catalina." For the past eight months the equipment has been functioning satisfactorily. The apparatus consists of an ordinary desk type microphone, a small transmitter, a superheterodyne receiver and a loud speaker. Both the transmitting and receiving sets are sealed, rendering them fool-proof.

The transmitter operates on a wavelength of 109 meters and under favorable conditions has a range of 200 miles. Passengers on the ship can talk to the shore at all times through the agency of a transmitter and receiver placed on the company's docks. Orders for the tugboats are now sent by means of the radiophone installation and considerable time is thus saved. The captain no longer has to bring his boat to dock after having finished a particular job. He signals the office when he has completed his work and is then given further instructions. Passengers have approved of the installations which afford them the means of keeping in touch with their friends on land. Several wrecks have been averted and many thousands of dollars in operating expenses have been saved through the use of the radiophone system. An operator is on duty at all times, both on the tugboats and the steamers. Besides affording an added means of rapid communication for the passengers, the mid-ocean radio has paid for itself many times over in directing the tugboats while at dock. Other steamship lines will undoubtedly follow the precedent established by the Wilmington Transportation Co.



The above illustration shows the mid-ocean radio telephone which has a 200-mile range and uses a wavelength of 109 meters.

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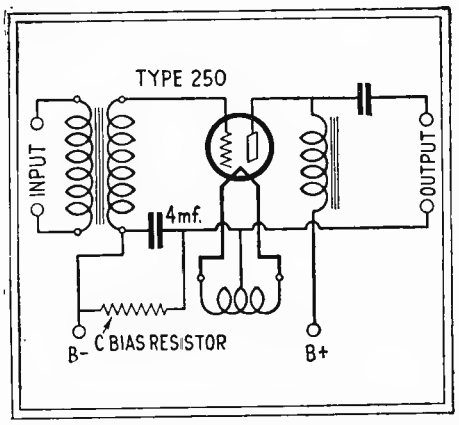
RADIO ORACLE

In this department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.



The circuit diagram shows how the voltage of the filament is fixed at 84 volts above the point where the grid return is made. The resistor used should be of the heavy duty type and if desirable may be variable, so that the correct "C" bias can be easily obtained if the plate voltage is changed, at any time.

"C" BIAS FOR THE 250

(649) M. Chiante, Fairchild, Wis., asks:

Q. 1. Will you please publish a diagram showing how I may obtain the necessary 'C' bias for my 250 power tube from the "B" supply.

A. 1. On this page you will find a diagram showing how this may be done. It will be seen that part of the "B" voltage is used to obtain the necessary "C" bias, therefore the voltage between the B+ and B— terminals will have to be raised. For instance, when using 450 volts on the plate, a negative grid bias of minus 84 volts is required. The voltage between the B+ and B— terminals in this case should be raised to 584 volts to compensate for the 84 volts being used on the grid. When using 250 volts on the plate, the "C" bias resistor should be rated at 1,600 ohms, with 300 volts the resistor should be 1,550 ohms, with 350 volts 1,400 ohms, with 400 volts 1,250 ohms, and with 450 volts 1,545 ohms. It will be noted that with 450 volts on the plate the "C" bias resistor is rated at 1,545 ohms, while with only 400 volts on the plate the resistor is rated at 1,250 ohms, obtaining a bias of minus 70½ volts when using 400 volts on the plate. With 450 volts on the plate a negative grid bias of minus 84 volts is used. It will be seen, therefore, that the increase in grid bias is disproportional, so that the plate current does not exceed 55 milliamperes when using 450 volts on the plate. The resistor used, as shown in the diagram, is inserted between the filament winding center tap and the "B" negative. A by-pass condenser of nearly 4 mfds, is inserted across the two resistor connections. The resistor should be of the heavy duty type, as it must handle up to 55 milliamperes at 84 volts for a single 250 tube, and 110 milliamperes at the same voltage when two such tubes are used. For any intermediate voltage not given here, the value of the resistor can be calculated by using Ohm's law. It must be borne in mind, however, that the voltage between the B+ and B— terminals should be equal to the plate voltage plus the grid voltage.

OSCILLATOR TROUBLE

(650) E. T. Bradford, Livingston, Montana, asks:

Q. 1. I am experiencing trouble with my superheterodyne receiver and have attributed the cause to the oscillator, which I think is not working properly. Is there any way in which I can determine if the oscillator is functioning properly?

A. 1. When the oscillator in a superheterodyne is not working properly, the "rushing" sound will not be heard and the receiver will have lost some of its energy. Sometimes, broadcast stations can still be tuned in, even though the oscillator is not working. The set is then functioning as a radio frequency receiver and signals can only be tuned in by rotating the tuning dial. Turning the oscillator dial does not affect tuning. A simple method of determining if the tube is oscillating is to touch the grid terminal with a piece of metal or with a moistened finger. If the oscillator tube is oscillating, a click will be heard in the headphones or speaker. Another test consists in tuning in a station and then removing the oscillator tube from its socket. If the signal still continues to be heard, the oscillator tube is not working properly. Another test is to connect a pair of phones in the plate circuit of the first detector between the plate terminal and the B+ lead, disconnecting the primary of the first intermediate frequency transformer. All the tubes, except the oscillator and first detector, should now be removed and a local station tuned in. The detector tube rheostat is now adjusted until the signal is just audible. The oscillator dial should now be rotated and if this causes a number of whistles, or if the signal becomes distorted or muffled, the oscillator tube is working properly. If no interference is noticed, the oscillator circuit is defective. Usually this will be found to be due to a poor tube, and when a new one is substituted, the set will again work satisfactorily. Connections should also be examined and sometimes the plate and grid leads to the coupling unit will be found to be reversed. The oscillator will not function if any section of the couping coil or the primary of the first intermediate transformer is short circuited. Lack of oscillation may also be caused by too low or too high a voltage on the oscillator tube.

LAMINATED BAKELITE

(651) John Kerney, Watertown, Mass., writes:

Q. 1. Will you outline briefly the process used in making laminated bakelite and if possible give some of its outstanding properties.

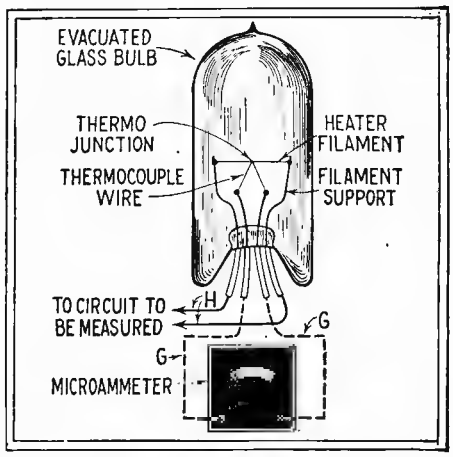
A. 1. For the manufacture of laminated bakelite, the initial or primary resinoid, which is obtained from the interaction of formaldehyde and phenol, is dissolved in solvents to produce a varnish. This is then used to impregnate the fabric or cloth. Impregnation is carried out with special machines which coat the paper or cloth with a uniform layer of varnish. These are then dried and cut into sheets of convenient size. A number of these sheets are then stacked up and placed in a hydraulic press where under the action of heat and pressure, a hard plate is produced. The final product cannot be resoftened by heat and is non-hygroscopic. The variety of properties available in laminated bakelite is determined by the amount of resinoid and by the type of laminating sheet used. Physically speaking, laminated bakelite is a dense uniform solid with a smooth and even surface and is obtainable in a number of colors. Mechanically, it is sufficiently strong so that it can be substituted for wood or metal in many cases. It is free from variation in structure and is stronger in some respects than cast iron. It has 90 per cent of the tensile strength of aluminum and only one-half the specific gravity. It is the most generally effective organic insulating substance, is more heat-resisting than shellac and more water-resistant than fiber. Its application in the electrical field and in radio work are familiar to all and are too numerous to mention here. Chemically, it is quite inert and is not attacked by most reagents. It is unaffected by most organic acids and by most dilute mineral acids. It is, however, attacked by hot alkaline solutions. For more information concerning laminated bakelite, we would suggest that you obtain a copy of *Bakelite Laminated* from the Bakelite Corp.

TUBE BRILLIANCY

(652) L. T. Gerschwin, Cedar Rapids, Iowa, asks:

Q. 1. I noticed that my 227 detector tube varies in brilliancy even when the voltage remains constant. Is this an indication of a defective tube?

A. 1. Occasionally it happens that the 227 tube does not always glow with the same brightness, even though there is no fluctuation in the operating voltage. The filament of the 227 is pure tungsten which is threaded through an insulating material. At the top of the structure, the filament is exposed and may be seen through the top of the bulb. A slight difference in contact at this point results in the increase in the operating temperature, which in turn changes the brilliancy of the filament. As the filament is operated below the melting point of tungsten, this temperature variation does not affect the performance of the tube. The fact that a tube may glow brilliantly is not necessarily an indication that it is overloaded.



The actual construction of a typical vacuum tube thermo-couple is illustrated here, connected to a D.C. galvanometer. The leads marked G and G come from the thermo couple wire, H and H from the heater filament.

THERMOCOUPLES

(653) C. A. McAndrews, Quebec, Canada, writes:

Q. 1. Please show the construction of a vacuum thermocouple and how this is used to measure small radio frequency currents of one-half ampere or less?

A. 1. In many radio experiments or in research work, accurate measurements of feeble alternating currents are essential. For measurements of currents present in radio receiving apparatus, a vacuum thermocouple, such as that shown on this page, is used. The heater element is caused to supply heat to a thermo junction which is connected to a sensitive microammeter. The heater element and thermo-junction are combined in one unit, known as a thermocouple. The combination of thermocouple and galvanometer may be calibrated by passing through the heater element a known direct current and the combination may thereafter be used to measure the value of an alternating current. Vacuum thermocouples measure the square root of the mean square of an alternating current and within wide limits, the accuracy is independent of the frequency of the alternating current. The inductance and capacity of vacuum thermocouples are so low that these factors can be considered negligible, except where extreme accuracy is required and when multiplier resistances are used. The smaller sizes have a heat lag which is negligible, and the larger show a greater lag. With the largest thermocouple, it takes approximately 30 seconds to reach the full value corresponding to the current being measured. The latest vacuum thermocouples consist essentially of a thermocouple composed of two wires of small diameter, the junction of which is attached to the midpoint of a heater element consisting of a length of resistance wire, the dimensions of which depend on the strength of the current to be measured and the sensitivity required. The heater and thermocouple element are connected to separate wires of low resistance and are sealed inside of a glass bulb which is evacuated to a pressure of 1×10^{-4} mm. or less.

CHOICE OF SPEAKER

(654) Wm. Pitt, Brooklyn, New York, asks:

Q. 1. I would like to know whether it would be better to use an electrodynamic speaker or the more common magnetic speaker?

A. 1. The electrodynamic speaker will give considerably better quality, especially when great volume is delivered. The volume produced by either type with a given input is about the same. One of the reasons why better quality is obtainable with the moving coil type speaker (as the electrodynamic speaker is often called) is that it is capable of producing pure low notes at frequencies below 100 cycles, which speakers with iron armatures cannot do. Furthermore, the iron armature speaker delivers a considerable part of the input energy at harmonics of the input frequency, especially with large volume. The mass and the elasticity of the iron armature mechanism also causes resonant distortion.

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Scientific Humor

DOUBLE IT AGAIN

WIFIE: "Do you think you'll invest in that gasoline substitute concern?"

HUBBY: "No, I figure the substitute would cost twice as much as the gasoline."

WIFIE: "Then wouldn't you make twice as much money?"—*Gleason Pease.*

JUST LIKE IT

Clerk in a Bird Hospital: "Sorry madam, we can't do anything for you, your bird is dead.

LADY: "I know he is, I just brought him in to match."—*Floyd Swanson.*

MIRTH—BERTH—HURT

JAKE: "Where did you get that black eye?"

BILL: "That's a berth-mark."

JAKE: "Birth-mark?"

BILL: "Yes, I climbed into the wrong berth."—*Eugene D. Yates.*

ANIMAL BLUSHES

LORD BULFINCH: "Is it possible the chameleon girl cares for that frog person?"

DUTCHESS CHEESEMORE: "It looks so. Every time he comes near she changes color."—*Mrs. George Smith.*

USEFUL LIMITED KNOWLEDGE

JOHN: "Are you familiar with any medical terms, professor?"

PROF: "Only two."

JOHN: "What are they?"

PROF: "Shake well before using, and $2.00, please."—*Mrs. George Smith.*

HOPE OURS DON'T

"My wife explored my pockets last night."

"What did she get?"

"Same as any explorer—material for a lecture."—*Martin Weiser.*

ANOTHER USE FOR IT

MOTHER: "And how did your teacher show you how fast to play?"

DORIS: "With a little windshield wiper she keeps on her piano."—*Gleason Pease.*

FIRST PRIZE $3.00

TELEVISION IS HERE

"Why, here's a wireless photo that you can recognize!"

"Yes, it came as a distinct surprise."—*Gleason Pease.*

THOUGHT IT WAS BLUFF

PROF.: "Microscopical investigations lead us to believe there are colors too delicate to be discerned by the human eye—invisible colors, we may call them."

STUDENT: "I know the name of one of them, sir."

PROF: "Indeed! What is it?"

STUDENT: "Blind man's buff."—*Bert Soppenfield.*

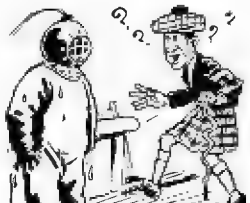
ALL jokes published here are paid for at a rate of $1.00 *each;* $3.00 *is paid for the best joke submitted each month.*

Jokes must have a scientific strain and should be original.

Write each joke on a separate sheet of paper and add your name and address to each.

Unavailable material cannot be returned.

A SHORT TRIP



Sandy, a Scotchman, had just arrived in the United States on a steamer. As he walked off the ship he saw a man in a diving outfit climbing up from the harbor to the deck.

"Mon! Mon," explained Sandy, "I wish I had known about that sooner, I'd have walked across myself."—*E. Snyder.*

ON THE SOCIAL SEA

"That dentist simply detests parties, but his wife makes him go with her."

"Yes, she's always dragging the yanker."—*Gleason Pease.*

SAW IT

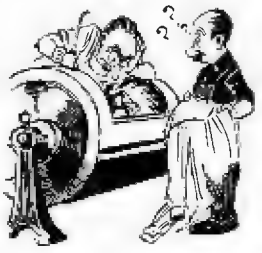
Victor told Ralph that he had seen the fourth dimension on the occasion of last New Year's eve, and in fact could explain it. Ralph was skeptical, so Victor began to expatiate:

"Last New Year's eve I was in pretty high spirits, and I took a walk down to the railroad yards to clear my head, as I was seeing kinda double. When I first glimpsed it there was a locomotive on the track, but the second time I looked there were two, and the third time there were three standing side by side. I got mad and looked again and I'll be danged if there wasn't the fourth dim engine."—*Max Bogner.*

ANOTHER SOURCE OF REVENUE

MECHANIC: "Something wrong with the machinery, eh?"

LAUNDRYMAN: "Yes. I don't know what it can be but we didn't get but five gallons of buttons this week."—*Gleason Pease.*



HEATED ARGUMENTS

Being a chemist's daughter, she made many hot retorts.—*Bert Soppenfield.*

RISING TEMPERATURE

Two colored boys were arguing about who was the thinnest of the two.

SAM: "Nigger, you is so thin, yo' ma could use yo' fo' a window."

RASTUS: "Dats nothing, child, yo' is so thin yo' ma could give you grapejuice and use yo' fo' a thermometer."—*F. W. Tatum.*

DISGUISED

WIFE: "Now that I have my hair bobbed, I don't look so much like an old woman."

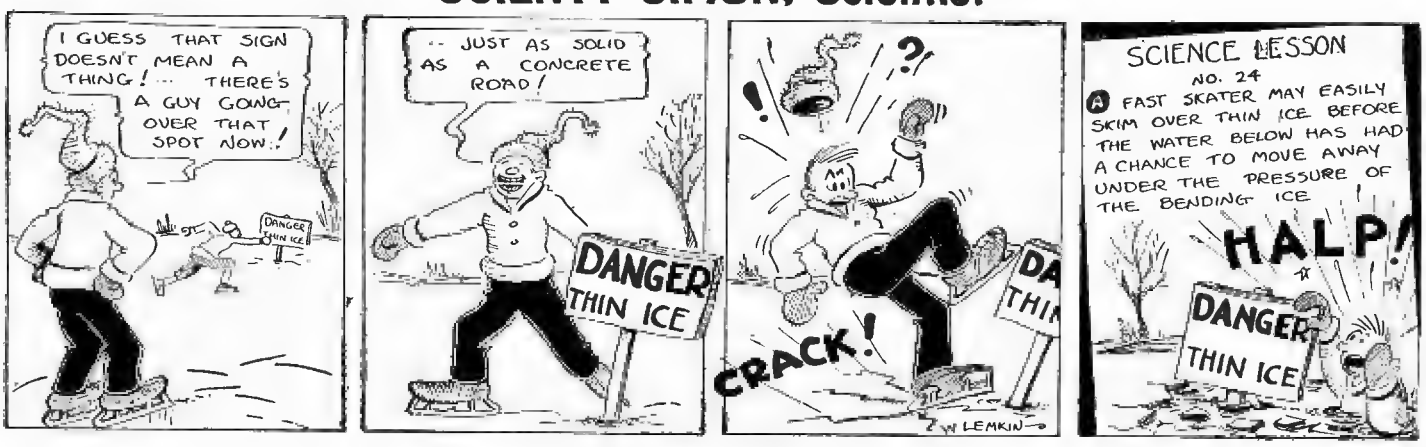
HUSBAND: "No. Now you look like an old man."—*Bernard Waynick.*

MURDER

MECHANIC TO MOTORIST: "Yes, sir. After careful examination I find your motor is shot."

MOTORIST: "I knew I had no business using that grease gun!"—*Clem Walker.*

SCIENTY SIMON, Scientist


I GUESS THAT SIGN DOESN'T MEAN A THING! ... THERE'S A GUY GOING OVER THAT SPOT NOW!
DANGER THIN ICE
... JUST AS SOLID AS A CONCRETE ROAD!
DANGER THIN ICE
?!
!
CRACK!
W LEMKIN
SCIENCE LESSON
NO. 24
A FAST SKATER MAY EASILY SKIM OVER THIN ICE BEFORE THE WATER BELOW HAS HAD A CHANCE TO MOVE AWAY UNDER THE PRESSURE OF THE BENDING ICE
HALP!
DANGER THIN ICE

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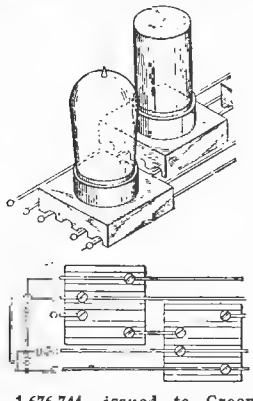
Latest Patents

LIGHT CIRCUIT INTERRUPTER

No. 1,584,586, issued to Carl H. Hauck. This device is shown being used in conjunction with Christmas tree lights to produce a twinkling effect. The interrupter is motor driven and geared so as to break the circuit about seven times per second.

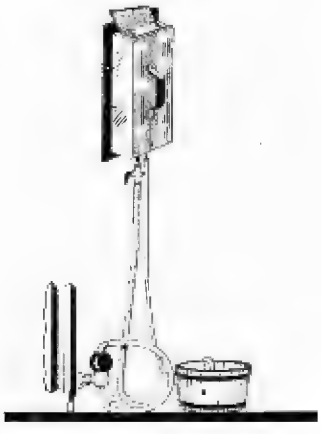
ALL RANGE AMPLIFIER



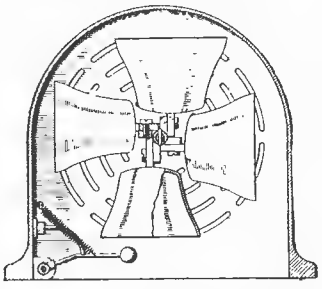
No. 1,676,744, issued to Greenleaf Whittier Pickard. This invention provides a thermionic amplifier which is easily adapted for use over various wave bands. The construction is such that it is a simple matter for the operator to change the range of his receiver and amplifier.

WALL PAPER REMOVER

No. 1,674,237, issued to Joseph Bauer. The wall paper remover shown here comprises a box forming a steam chamber which is attached to the steam line. It is fitted with a handle and a scraping edge, to facilitate the removal of the paper.

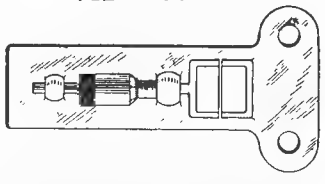


WARNING SIGNAL



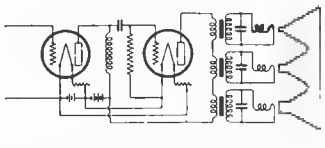
No. 1,664,871, issued to Hans Werder. This improved signal uses a number of rotable elements similar to the ordinary church bell, when the elements are rotated they strike a resiliently mounted clapper, thereby producing the signal. The elements may be chosen with different pitches, so that the produced signal will have a pleasing sound instead of the usual harsh and offensive signals now prevalent. This signal may be used instead of the usual type of automobile or motor launch signal.

VIBROSCOPE



No. 1,673,949, issued to Thomas C. Rathbone. This instrument is capable of accurately indicating the amplitude of vibration of a body vibrating or oscilliating from any cause. The indicia consists of a number of pairs of lines, each pair being spaced at progressively increasing distance, the extent of the spacing being indicated on an adjacent scale. When in vibration, all the lines are blurred, except the pair separated by a distance equal to the amplitude of vibration.

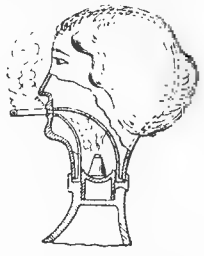
LOUD SPEAKER SYSTEM



No. 1,675,031, issued to Fredrick A. Kolster. This loud speaker utilizes a number of units, each unit being required to operate efficiently and without distortion over a limited portion of the audio frequency band. Each unit is constructed to be resonant at a different point in the audio frequency band, consequently, no matter at what frequency the input energy is supplied, one of the units is operating at or near maximum efficiency. It is claimed that an over-all uniform response between 50 and 10,000 cycles is hereby made possible.

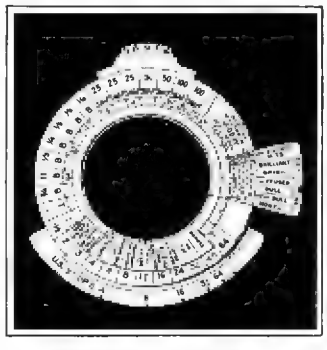
INCENSE BURNER

No. 1,671,512, issued to Ellen V. Cheeseman. This burner constitutes a novelty suitable for use as a novelty doll, and for prizes at amusement concessions and like places. Unlike the usual incense burner, it does not have tendency to become hot or scorch surfaces in contact with it. Furthermore, it is easily moved without burning the fingers.



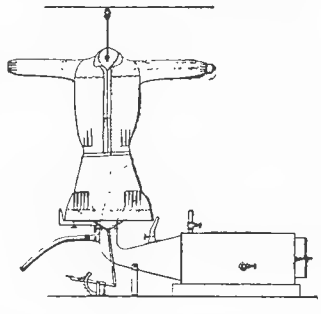
PHOTOGRAPHIC EXPOSURE CALCULATOR

No. 1,664,818, issued to John R. Hewett. The factors which determine the proper time of exposure and choice of stop to be used when taking pictures at any given time and place, such as the time of day, latitude, etc., are correctly correlated by one simple adjustment of the calculator. The calculator is mounted about the lens tube of the camera.

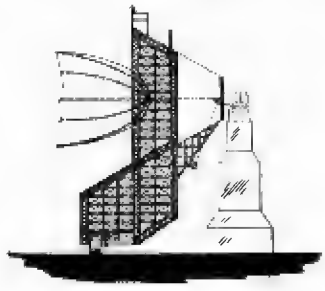


GARMENT DRIER

No. 1,670,423, issued to Edward B. Ruby. Garments are placed in the drier as shown here, and hot dry air is ejected from the supporting members. Garments dried in this way are left unwrinkled, when silk goods are dried in this way, the agitation during the drying period prevents shrinkage.

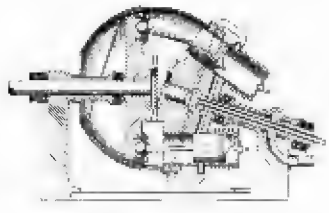


AIRSHIP ANCHORAGE



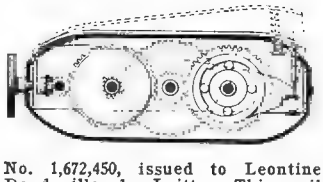
No. 1,670,707, issued to William Auberlin. This invention provides a means for safely mooring an airship to a mast, especially where a strong wind is blowing. The structure includes the wind-shield which can be turned around the tower by a motor, to the position required, which of course depends upon the direction of the wind. The structure itself has comparatively little wind resistance, due to its open framework construction, while the windshield need be only slightly larger than the nose of the ship.

ROTARY ENGINE



No. 1,673,632, issued to Victor C. Mattson. The construction of this internal combustion engine is such that the reciprocating movement of the ordinary type is avoided, due to the fact that the motion is rotary throughout, except so far as the pistons and their connecting rods are concerned. The feature of the motor is its smooth operation, being almost entirely without vibration.

NAIL FILING AND POLISHING DEVICE



No. 1,672,450, issued to Leontine Dandeville de Laitte. This nail filing and polishing device carries a filing or buffing wheel, and its size and shape is such that it may readily be clasped on one hand while filing or polishing the fingers on another hand. The buffing member is readily detachable and the filing disc quickly and easily substituted. The device utilizes a flywheel as shown at the left of the illustration, as the power supplied to the grinding and buffing members is supplied intermittently.

NOTICE TO READERS: The above illustrated and described devices have recently been issued patent protection, but are not as yet, to our knowledge, available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the above devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of the application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information, as it is practically impossible to obtain up-to-date addresses. —EDITOR

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The Oracle

The "Oracle" is for the benefit of our scientific student readers. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculation, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

HELIUM

(2277) G. Micado, Prague, Okla., asks:

Q. 1. Please give me some information concerning the uses to which helium can be put and also if it is now available on the open market.

A. 1. Helium gas, which has heretofore been considered a rare element and not obtainable on the open market, is now available in commercial quantities. Unusual interest is being manifested in its physical and chemical characteristics in the field of science, and because of its unusual properties, it is expected that new fields of usefulness will be discovered and developed for the benefit of industry.

The story of helium affords a striking example of the way in which unexpected values accrue from fundamental research. The gas was first discovered in the sun during the time of the solar eclipse of August 18, 1868. In 1895, Ramsey, searching for additional sources of the newly discovered element argon, discovered traces of helium in the mineral cleveite. Later, traces of helium were found in Canada and still later in France. It was observed that helium was always found in natural gas in the vicinity of minerals of a radio-active nature. During the World War, Doctor Ramsey suggested to our war department that they seek helium in certain natural gas fields, where the radio-active minerals were present. His theory proved to be correct and the search for helium was successful. An extraction plant was then erected in Texas to supply helium exclusively for the use of the United States Government in balloons.

More recently, helium has been made available commercially by the discovery of new natural gas fields having a higher helium content and the development of an improved process of extraction by The Helium Company, whose plant is at Dexter, Kansas, with headquarters at Louisville, Kentucky.

The first and most important use of helium to date is for inflating dirigible and passenger balloons, of the Shenandoah and Los Angeles type. Because of the fire and explosion hazard, the use of a combustible gas for inflating passenger balloons has been banned by the U. S. Government. Helium is absolutely non-inflammable and its lifting power is but little less than that of hydrogen. Because of these two characteristics—lightness and non-inflammability—it is also being used extensively for filling toy balloons that float in the air for purposes of advertising and entertainment.

Another development is the use of helium to make a synthetic atmosphere of oxygen and helium for deep sea diving and caisson work involving labor under abnormally high pressure. The use of helium for this purpose minimizes the danger of "the bends" or "caisson sickness." This extremely painful and sometimes fatal ailment is believed to be due to the release of nitrogen previously dissolved in the blood due to excess pressure. The advantage of helium in this instance is that it is not only more inert than nitrogen, but has the lowest solubility in water of any gas known. The tendency therefore is to increase the limits of the pressure at which work of this kind can be performed, greater depths in diving work, for instance. It also lessens the time of compression and decompression of the operator, which is an important factor.

Helium not only has low solubility in water, but is also practically insoluble in molten metals. For this reason, it is used in preference to other non-oxidizing gases such as nitrogen and hydrogen, in annealing processes and metallurgical operations. It is also used as a damper for nautical and other scientific instruments because of its high viscosity, which is greater than that of air, its high thermal conductivity, which is more than six times that of air, its high specific heat, and low dielectric constant, etc. It is being used for filling radio tubes and glow lamps and tubes for signs and as a cooling medium in electric transformers and high speed generators. Helium has the lowest boiling point known—267.9 degrees C.

Drying operation is another field in which helium can be utilized to speed up operation and make products of superior quality. Water and other solvents have a higher vapor pressure and consequently will evaporate more rapidly in an atmosphere of helium than in the air or a vacuum. Because it is chemically inert, has high heat conductivity and low density and can therefore be circulated rapidly, it is particularly suitable for drying organic and inorganic chemicals quickly and efficiently.

Due to its practical insolubility helium may also be used advantageously in the manufacture of toilet preparations for homogenizing creams, soaps, pastes, etc.

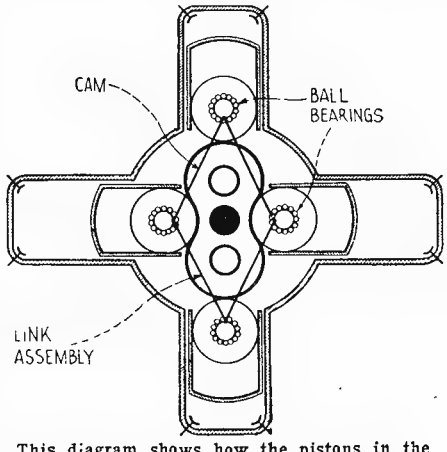
To date, the field of usefulness of helium has been developed because of its low specific gravity, its chemical inertness and its low solubility. Some of the other properties are undoubtedly of equal importance and new developments in industry can therefore be anticipated with the aid of scientific research in new directions.

FAIRCHILD CAMINEZ MOTOR

(2278) B. Adagio, Bayonne, New Jersey, writes:

Q. 1. Will you please publish a drawing of the Fairchild-Caminez cam motor and also tell me something of its construction.

A. 1. On this page you will find a drawing



This diagram shows how the pistons in the Fairchild-Caminez aircraft engines operate without any connecting rods or crankshaft.

showing the principle of the cam motor. This engine is a four-cylinder stationary radial cooled motor and operates on the four-cycle principle. It has a cam type drive and is characterized by a high power output at low propeller speed. Large overhead valves are used and the bore of 5⅝ in. and the stroke of 4½ in. make 135 horsepower available at 1,000 R.P.M. of the propeller. The motor weighs 340 pounds, with the exception of starter and propeller hub. Due to the low speed of rotation, propellers from 10 to 10½ ft. in diameter may be used with some types of this engine. The clearance between the roller and cam is 1/64 in. The cylinders have aluminum alloy heads, which are screwed and shrunk into steel-finned sleeves. Cooling fins are machined on the steel cylinders. Cylinders are bolted to the case but heat-treated piston guides extend into the aluminum alloy case, so the piston at no time overruns the cylinder. In place of the usual crankshaft and connecting rods, a driving cam is fixed to the main shaft. The rollers in the pistons bear upon this cam and are kept in contact with it by two sets of piston interconnecting links. The mainshaft is a straight hollow shaft, 22 in. long, and is made of alloy steel. The pistons are made of an aluminum alloy with piston pins of hardened alloy steel on which are mounted double roller bearings serving to transmit the power to the driving cam. The main engine case or cam case consists of two heat-treated aluminum alloy castings. The principle of operation is as follows: Each of the four pistons during one revolution of the crankshaft completes the four strokes, namely, suction, compression, power and exhaust. Other four-cycle engines require two revolutions of the crankshaft.

HIGH-FREQUENCY EXPERIMENTS

(2279) H. E. Bohec, East Rutherford, N. J., writes:

Q. 1. I am enclosing a diagram showing how I intend to use an Oudin coil in performing some high-frequency experiments. Kindly give me your opinion of this, and if it is advisable to employ the electric-chair stunt which was published in the May issue of SCIENCE & INVENTION.

A. 1. In looking over the diagram which we published, it will be seen that when the performer who sits in the chair grasps the piece of wire which is connected to the ground, the electric spark jumps between the two without passing through his body. The only danger involved is the possibility of getting a spark through the body to the ground. It is, of course, much more agreeable to perform the experiment according to the diagram which you show. The performer sits or stands on an insulated platform and simply absorbs the high-frequency current from the free electrode or ball terminal of the Oudin coil. In performing the experiment as shown in this magazine, a heavily-insulated ground cable should be used, and a well-insulated handle employed at the end of the ground wire, which the performer holds. Further, it is advisable for the performer's assistant to throw the Oudin coil into the circuit, when the man in the chair has brought the grounded electrode into close proximity to the metal electrode on the front of the head harness.

COLORING FOIL

(2280) D. B. Ramsay, Hanover, New Hampshire, asks:

Q. 1. Is there any process whereby tinfoil can be given a gold color?

A. 1. For a permanent gold color the following method is recommended. The tinfoil used should first be washed with gasoline until thoroughly cleaned. It is then dried and placed in an oven where the foil is heated to a temperature of about 400 degrees F. The foil is held at the temperature mentioned for a period of four to twelve hours, the time being dependent upon the size of the foil under treatment. The heating process should be continued until there is a uniformity in the gold coloring over the entire surface of both the front and the back. Either tinfoil or alloy foil may be subjected to this process.

The process described here is understood to be one of oxidation. The oxidation of the surface of the foil produces the gold color which is desired. In order to insure a uniformity of coloring, the foil should be retained in the oven after the heat has been cut off and allowed to cool slowly, thus completing the coloring operation. When the oven has become cooled, the foil may be removed. The higher the temperature, within certain limits, the deeper will be the gold color.

CELLULOID SOLVENTS

(2281) G. C. Mackintosh, Boston, Mass., asks:

Q. 1. What are the principal celluloid solvents?

A. 1. Celluloid dissolves in acetone, sulphuric ether, alcohol, oil of turpentine, benzine, amyl acetate, and the like. Various combinations of these agents may also be used.

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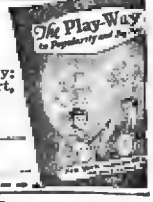

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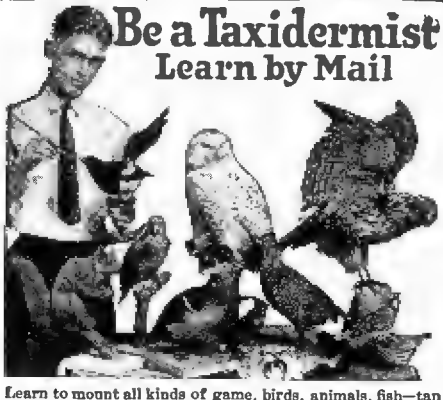

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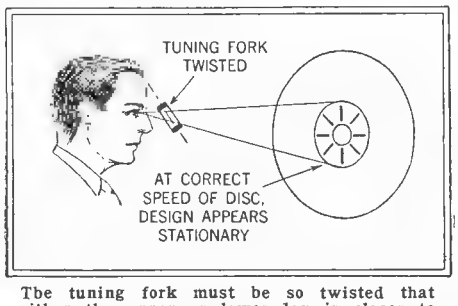
How to Build S. & I. Television Receiver

(*Continued from page 620*)

to the neon tube. The terminal posts to the neon tube circuit are mounted on a piece of bakelite, secured to the rear left corner of the baseboard. A rubber foot should be placed under each corner of the baseboard; this will allow the wiring to be simply placed against the wood and held in place with a few staples, if necessary. The clarostats are mounted on small right-angle brackets made from brass or iron. The push-button is placed in a tight-fitting hole, bored through one corner of the baseboard. The 110-volt supply for the motor circuit is brought into the apparatus, through an approved socket or receptacle, mounted on the righthand side of the baseboard, as shown in the picture.

OPERATING THE APPARATUS

WHEN the television signal is being received and the neon tube is connected to the output of the radio receiving set (and providing there is sufficient voltage used in the last stage—not less than 180) pulsations of pinkish light will be seen in the neon tube. If a sufficiently high voltage is used and the radio apparatus is properly adjusted with regard to the "C" bias, etc., then a pulsating pinkish light should be seen covering the whole neon tube plate which



The tuning fork must be so twisted that either the upper or lower leg is closer to the eye. The aperture between the legs should be very small. The entire pattern can be viewed if the fork is held close to the eyes.

faces the rear of the television disc. If the pulsating glow is seen on the rear plate, then the wires leading to the neon tube must be reversed.

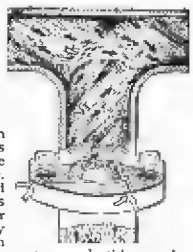
If you are "looking in" with the television receiver, and, having checked the time of the television broadcast with the newspaper program, you should first check the motor speed and make certain that it is revolving at the prescribed speed. As you look into the viewing visor, preferably in a darkened corner of the room, you will see successive lines of orange-colored light as the spiral of holes repeatedly scans the illuminated plate in the neon tube. If you see these bands of light, but they only form irregular splotches, then the chances are that your motor speed is either too high or too low, and a slight change in the rheostats should be made. It is well to recheck the speed of the revolving disc with the stroboscope fork after doing this, as you may change the speed too much.

Several things may happen if you are successful in building up a picture image with the machine; the image may be upside down or it may slowly drift across the viewing lens repeatedly. If the picture slowly drifts across the lens, then the motor speed should be momentarily accelerated by pushing the button connected across the smaller resistance. This presupposes that the motor is running slightly below the correct television speed for the station to which you are "looking in." You may have to change the small

(*Continued on page 634*)

Is Your Car..... A Gas Eater

New Invention Increases Mileage on Auto Gas Eater from 13½ to 34.6 Miles on a Gallon



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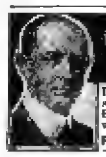

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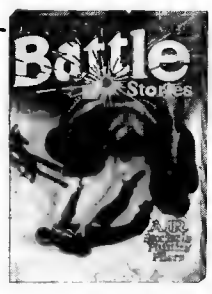

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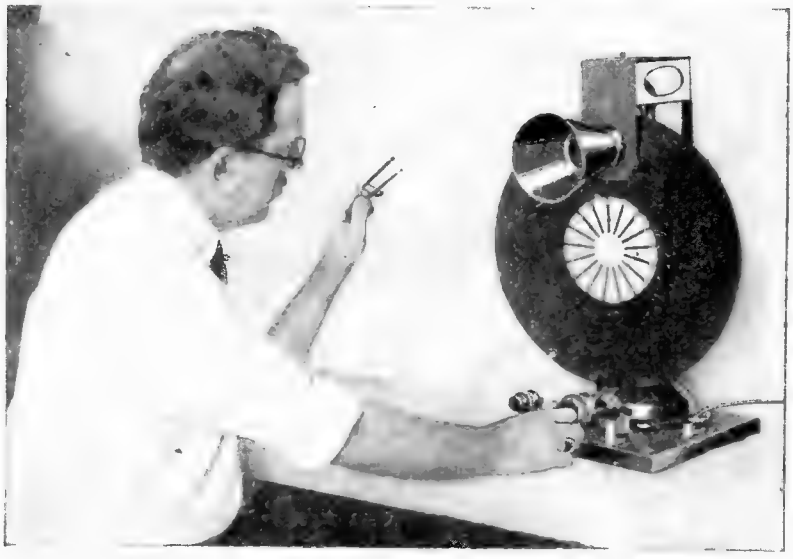
HOW TO BUILD S & I TELEVISION RECEIVER

(Continued from page 632)



The photograph shows operator checking the speed of the television receiver by means of a tuning fork and a patterned disc. When viewed through the tines of a vibrating fork, the pattern remains stationary, exactly as you see it here.

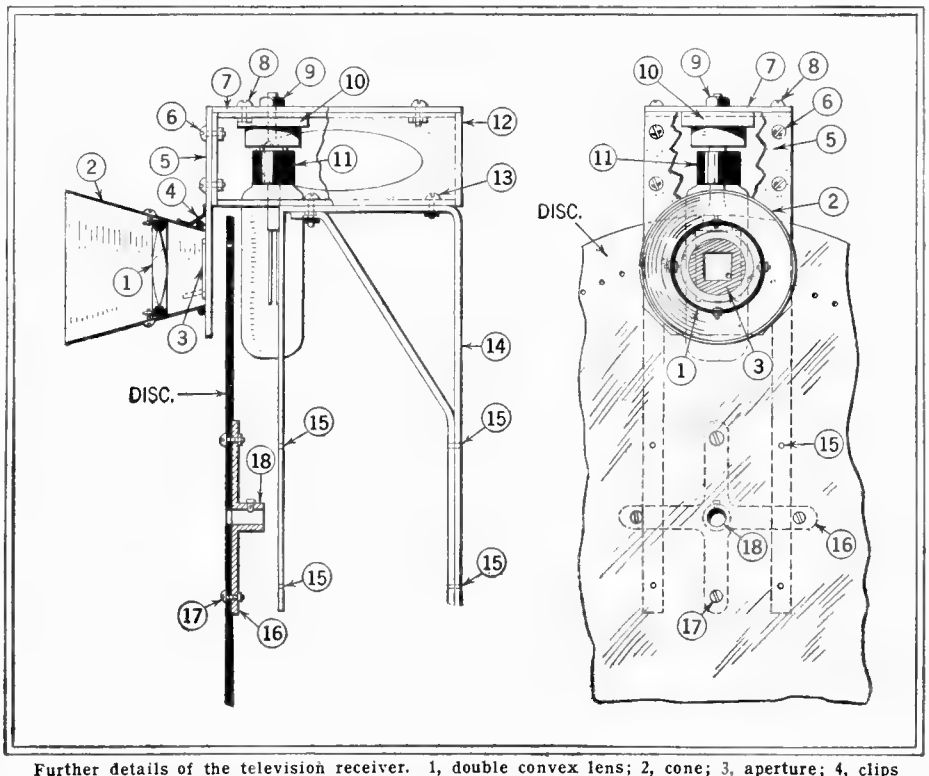
variable resistance or even adjust the larger one slowly in order to make the picture stationary on the lens.

If the picture is upside down, then you are scanning the neon tube plate in reverse order; that is, from bottom to top, instead of top to bottom, and the disc must be taken off and turned around. In some cases it will be necessary to turn the disc around and also reverse the motor, or in still other instances, in order to rectify the picture image, the direction of the motor rotation will have to be reversed.

If the motor happens to be of the universal type, which means that it is usually a series-wound motor, then the direction of rotation can be changed by simply reversing the connections to the field or to the armature brushes. If the motor is an A.C. induction type, with a separate starting winding, then the direction of rotation is reversed by simply transposing the terminals from the starting winding. If the motor happens to be one of those types using copper shading plates, mounted on the tips of the iron stator poles, then the direction of rotation can be effected by remounting the shading plates on the opposite pole tips; or simpler still, the whole stator frame may be removed from the car-case or motor housing, and reversed in its position with respect to the same.

In some cases direction of rotation of the motor may be effected by sliding the shaft out of the rear bearing and then turning the motor around. This is rarely the case, but with some induction motors it is pos-

(Continued on page 636)



Further details of the television receiver. 1, double convex lens; 2, cone; 3, aperture; 4, clips for holding cone; 5, face plate; 6, screws for holding same; 7, top; 8, screws for bolting to plates 12; 9, single hole mounting of socket 10; 11, neon lamp; 13, bolts for holding plate 12 to upright 14; 15, holes for mounting uprights to motor; 16, mounting for disk held in place by screws 17; 18, shaft mounting.

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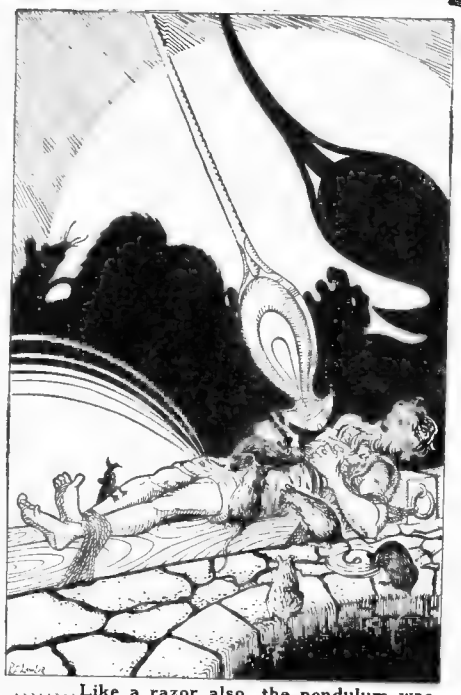

.....Like a razor also, the pendulum was massy and heavy, it was appended to a weighty rod of brass, and the whole *hissed* as it swung through the air. I saw that the crescent was designed to cross the region of the heart. Down—steadily down it crept. The rats were wild, bold, ravenous, their red eyes glaring upon me. And then.....

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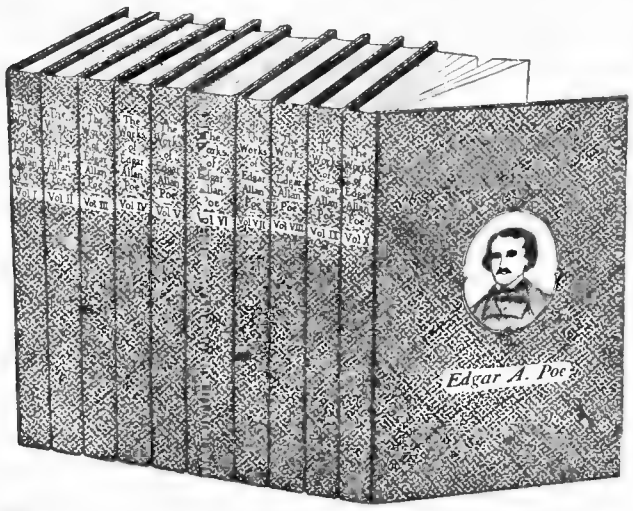

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HOW TO BUILD S & I TELEVISION RECEIVER

(*Continued from page* 634)

sible to do this, the rotor being secured to the shaft by a set screw.

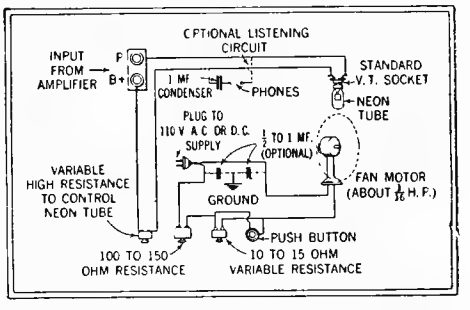
The television set builder who is interested in the connections of the resistance-coupled amplifier, and other details connected with the radio receiving set, should read all about this matter, where complete diagrams are given with explanatory remarks, in the *Television* magazine, Volume I, No. 2. Various methods of connecting the neon television lamp are supplied by some of the manufacturers putting out these tubes. The common connection for the neon lamp, however, is in series with the plate and "B+" supply wire; in other words, it is connected in the same relative position as your loud speaker. Some of the neon lamps, however, are supposed to be checked carefully with a milliammeter, so that no more than a certain current in milliamperes is passed through them, in order to conserve their life. When using one of these more sensitive type neon lamps, it will be found necessary to connect a clarostat, or other fairly high variable resistance, in series with the "B" supply, before it reaches the neon tube. This series variable resistance in the neon tube circuit may have a range of 0 to 10,000 ohms. A fixed resistance of 10,000 ohms, with a variable 1,000-ohm resistance, may be used. In the *Television* magazine, Volume I, No. 2, already referred to, details will be found for making your own rheostats for the speed control of the motor, as well as data for building an adjustable impedance for those using A.C. motors; the variable impedance being preferable to variable resistance control, where alternating current is used.

When all ready to listen in for a television signal, you will soon become accustomed to the peculiar whining note of the television signal proper; and if you follow the published program of WRNY, for example, you will receive the proper introduction by the announcer, and then you will make no mistake when you hear the television signals in your phones.

If you "listen in" to the station at first with a pair of headphones and plug them into the detector jack on your set, this is all right; but if you connect your headphones in the last stage wherein the neon tube is connected, be sure to connect a 1 micro-farad condenser in series with the phones, when connecting them in the place of the neon lamp, or across the neon lamp terminals. The television signal sounds in general like a buzz saw cutting through a plank, and the note continually changes as the person in front of the television transmitter moves about.

NEON TUBE NOTES

IN adjusting the neon tube circuit, it is the usual practice to adjust the "C" bias on the last amplifier stage, so that the tube just glows over the plate facing the rear of the revolving disc. In other cases the neon lamp is adjusted by raising the "C" bias potential on the last amplifier tube, so that



Above is a schematic diagram of the Science and Invention television receiver. A push button cutting a resistance out of the circuit speeds up the motor when necessary.

the neon lamp doesn't quite glow. In this case, when the television signal comes in, the lamp lights up as the television signal pulses are impressed on the circuit. In some cases it may be possible that you see the image in negative form instead of positive, i. e., you may see the image similar to a photographic negative. In this case the connections to one of the amplifier stages should be reversed; at other times it will be found that if the tuning dial of the set, or one of the dials, if it has more than one, may have to be moved from the right side of the peak of the carrier wave, so to speak, to the left side and vice versa. That is, if you had tuned the dial to say 45 degrees for maximum signal strength, and then detuned a little toward the left; you may have to detune toward the right of the peak, 45 degrees, in order to reverse the image.

Another reason for a reversal of the image from positive to negative is that a certain number of stages has to be used with a specified form of detector circuit; this is explained at length in an article covering an interview with Mr. C. F. Jenkins' radio engineer, which appears in *Television* magazine, Volume I, No. 2, page 8.

If you happen to see the television image on the lens right side up reversed, you will have to reverse the direction of rotation of the motor and also remove the disc from the shaft and turn it around with the other side out.

HOME MOVIES

Conducted by DON BENNETT

(*Continued from page* 609)

The Movie Question Box

(This department is conducted for the benefit of the readers of SCIENCE AND INVENTION *and we will gladly answer any question relating to home movies except those that require a comparison of various products. Questions relating to the use of 9mm, 16mm or 35mm are all within the scope of this department. Address your questions to THE HOME MOVIES EDITOR,* SCIENCE AND INVENTION, *230 Fifth Avenue, New York, N. Y.)*

MAKING OWN CAMERA AND PROJECTOR

Willis E. Broyda asks:

Q. Could you give me some information regarding the possibility of an amateur making a movie camera and projector?

A. The manufacture of motion picture equipment is a job requiring excellent tools and great mechanical knowledge. It would cost much more than to purchase an outfit and the results would never be as good. If you would like to experiment, I would suggest that you get some second-hand parts and assemble them. This will eliminate the delicate work associated with the film pull-down mechanism and at the same time would give you a better chance to turn out a working instrument.

MOVIES OF FIREWORKS

James J. Corona asks:

Q. Is it possible to take pictures of fireworks at night time?

A. Yes, and without any addition to your equipment. That is providing you have a

(*Continued on page* 639)

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How Lindbergh's Famous Engine Was Manufactured

By H. W. SECOR

(*Continued from page 591*)

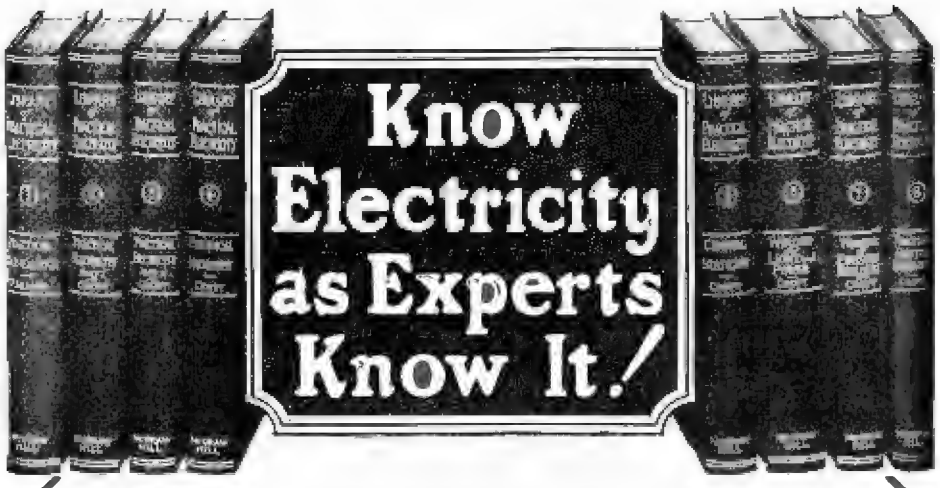
writer saw and "heard" on test. "Heard" is correct. To more strongly impress this visit on the reader's mind, it should be mentioned that with this larger size engine the exhaust pipes from the cylinders were not connected to the usual pipe manifold, but the exhaust from each cylinder shot directly out into the atmosphere. The blast of heat from the four-foot flame exhaust discharges from the nine cylinders was so intense that one had to practically run by the test room door opening, at a distance of thirty feet. One can also feel the breeze from these engines under test as they are whirling round a spcial four-bladed club propeller, this propeller having been calibrated previously. This propeller acts as a load for the engine, and also gives the engines the necessary factors by which to measure the output of the engine at various speeds.

The company building these engines is also developing a new twelve cylinder 600 horse-power "V" type airplane engine with air-cooled cylinders. This concern also builds a very powerful twelve cylinder marine engine for use in speed boats and launches. Asked the reason why an inverted "V" type engine was used, one of the engineers explained that this was preferred to the upright "V" type, owing to the greater visibility afforded the pilot of the plane equipped with this type of engine. Knowing how easily some automobile engines become flooded with oil, without being inverted, the writer inquired as to how the inverted "V" engine overcame the oil flooding problem. One can imagine what would happen if we took an ordinary automobile engine and turned it upside down. The cylinders would be filled with oil, and very shortly would cease to function without a doubt. This very interesting problem had been solved, it was stated, by arranging two suitable oil pumps, so that practically all of the bearings are fed with oil under forced pressure, through ducts and pipes. In other words, the oil is pumped through the engine bearing system and withdrawn from any point of accumulation as fast as it collects.

It is very interesting to note that when developing a new cylinder or cylinder head, connecting rod, etc., for a given type of engine, that a whole set of nine cylinders or other parts is not required in order to make a research test on the new metal or new shape, as the case may be. In one of the research departments, a provision is made for running and observing a single cylinder with crankshaft and one connecting rod together with one piston, etc. In other words, the new part is tested in the form of a one cylinder engine. After running this for a number of hours and carefully measuring the parts, as well as testing them for strength and chemical make-up, suitable engineering data is thus obtained and given to the chief engineer. This saves a lot of time and money, especially when many different metals or shapes of certain parts are to be tested and their merits or demerits ascertained by the research experts.

PROCEDURE IN AIRPLANE ENGINE TEST

THE parts for the air-cooled engines which have been finally approved are stored in bins adjacent to the assembly floor, withdrawn and partially assembled at the tables, and then finally used in building up the completed engine. Even at this point the parts for an individual engine are subjected to careful scrutiny so that the finished product may be as nearly perfect as is possible from the standpoint of fit, balance, etc.



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The engine is next subjected to two hours of running at nine-tenths rated load (1750 r.p.m.—180 h.p.).

Throughout this running significant readings are taken and noted on the engine log sheet.

Following this initial test the engine is cleaned externally and completely disassembled. The parts for one complete engine are laid out carefully on a double-decked table and are given a very careful inspection. Every part is examined for wear and notations are made on a standard inspection sheet. After having been approved by the inspector, the engine is reassembled of the original parts and taken to the final test stand. During reassembly any necessary minor substitutions of parts are made and the valves are again carefully ground.

At the final test stand another initial running-in is given which consists as before of the easy stages of running at successively higher speeds varying between 800 and 1750 r.p.m. The total run-in in this case amounts to about one hour of operation.

The engine is then run for one-half hour at nine-tenths rated power (1750 r.p.m.—180 h.p.), and one-half hour at rated power (1800 r.p.m.—200 h.p.). In both these runs the fuel and oil consumption are carefully checked and no engine is approved unless these readings are within specifications. The specified maximum fuel consumption is .55 lbs. h.p. hr., and the corresponding figure for oil consumption is .025 lbs. h.p. hr.

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In the event that all these tests have been passed successfully, the engine is then cleaned and made ready for shipment. If, however, any major part, such as a piston, master rod bearing, cylinder, cam, etc., is replaced on disassembly, what is known as a "penalty test" is carried out in addition to the regular procedure. This test is made previous to the final testing outlined above and consists of a one-hour run-in at nine-tenths rated horse-power, after which the engine is sufficiently disassembled to determine the condition of the part replaced. All being in order the final testing proceeds as outlined.

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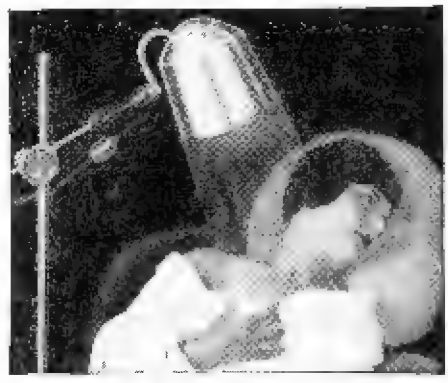

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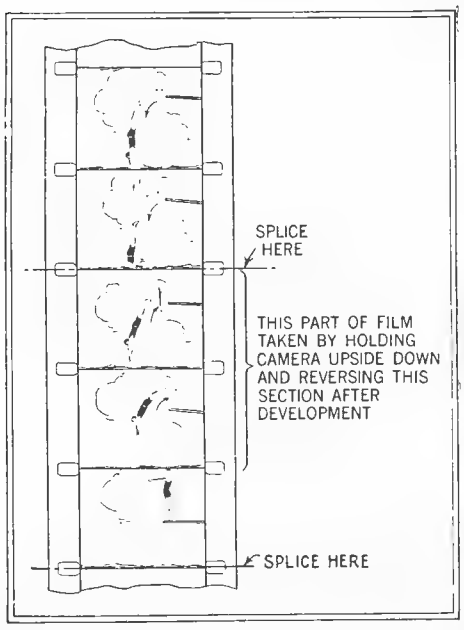
HOME MOVIES

(*Continued from page 636*)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THIS PART OF FILM TAKEN BY HOLDING CAMERA UPSIDE DOWN AND REVERSING THIS SECTION AFTER DEVELOPMENT
SPLICE HERE

People in any scene can be made to move backwards by holding the camera upside-down and splicing the film as shown.

lens at least as fast as F 3.5. An F 1.9 lens is even better, but with panchromatic film, and no filter, you should get good pictures if fairly close to the display. All red or all green will not affect the emulsion very much and I would suggest that you double and triple expose your scenes. To do this, after making a shot, turn back the film by opening the camera in the dark and unthreading. It is best to start a fresh roll as the paper leader will serve as a guide.

Niagara Falls and similar all-white displays should be photographed from such a distance that some of the dark background will be included in the scene, otherwise the film will be solid white with little to relieve the monotony. Better stop down half a point too, on these all-white displays. When taking a display that is all in colors, slow the camera down a trifle, to about twelve exposures per second. If your camera is not adjustable, open wide and trust to luck.

Photoplay Review

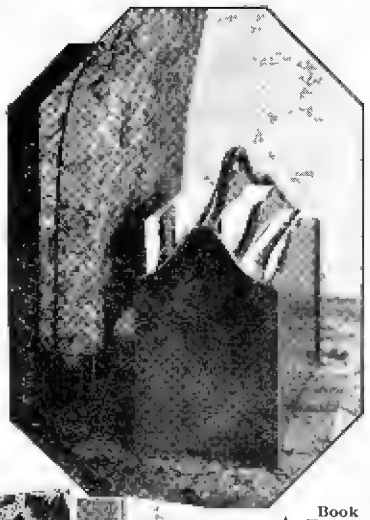
With this issue, SCIENCE AND INVENTION *starts a new feature as a part of the HOME MOVIES Department. Each month we will present a review of one or more pictures that are outstanding from a technical viewpoint, the story and cast not receiving mention unless because of exceptional merit.*

The films reviewed here have been studied with the amateur foremost in our minds. We will try to point out the features of each picture that are of special interest to the amateur and, when space permits, will describe any special features or tricks.

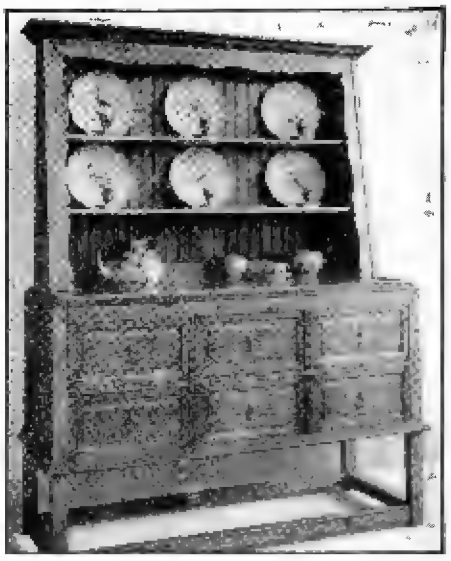
WHITE SHADOWS IN THE SOUTH SEAS

"White Shadows in the South Seas" (Metro-Goldwyn-Mayer) is one of the most interesting and educational pictures that it has been our privilege to watch. It was made in the Marquesan Islands, with an almost 100 per cent native cast and is therefore almost an amateur motion picture. It shows what can be done with amateur actors when the direction is competent. The photography throughout is perfect, panchro-

(*Continued on page 666*)



Book Trough and Magazine Stand
See LePage's Book, page 19



Old Salem Ship's Cupboard
See LePage's Book, page 5

Modernistic Folding Screen
See LePage's Book page 12

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There is, of course, a limit to what we can give in LePage's New Third Home Work Shop Book for only a dime. But we realize many men want additional projects. Hence our 12 new Job Plans. These also were made by Mr. Klenke. They are projects that require more elaborate presentation than we can give in our book. Each Job Plan presents one project on a single large sheet of paper. Each is well worth its price, one dime. Look over these projects and order those you want by number (see coupon), enclosing 10 cents for each.

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LePage's latest book, the new "Third Home Work Shop Book," contains complete, easy-to-follow directions for making 20 attractive pieces of household furniture, of which 17 are entirely new and never offered before.

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Designed by Expert

All the designs, dimension drawings, actual pieces and photographs were made by William W. Klenke, Instructor in Woodworking, Central Commercial and Manual Training High School, Newark, New Jersey. Also the designer of the first two LePage's Books. Each project and the directions for making it are perfectly practical.

Each project is presented in three parts—a photographic illustration of the finished project, a complete dimension drawing of its parts, and simple, easy-to-follow, step-by-step directions.

In addition to the three pieces shown above, the book includes the following: Cape Cod Chest of Drawers, Alexandria Nest of Tables, Lady Washington Sewing Cabinet, Modernistic Book Shelves, Desk, Table, and Fire Screen, Smoking Table, Caned Side Chair, China or Book Cabinet, Magazine Carrier, Vanity Case, Book Stand, Fernery Stand, Folding Sewing Screen, Plymouth Built-In China Closet, and Chess and Checkers Table. Where else could you get complete directions for making all these for only 10 cents?

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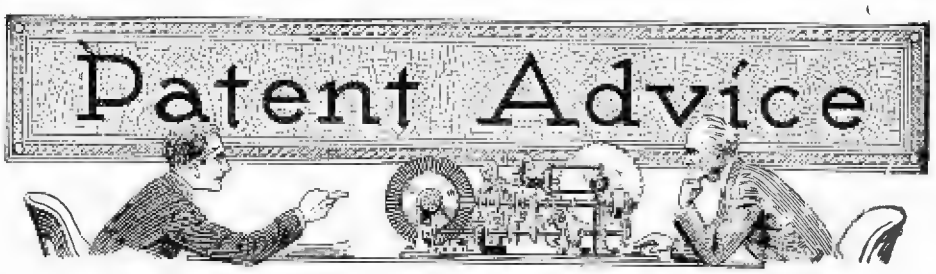

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NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

DEMOUNTABLE RIM

(1130) Mark A. Hutton, Kingston Springs, Tenn., has advanced the suggestion for a new demountable rim for automobiles and requests our advice on the same.

A. 1. The suggestion which you have advanced for an auto wheel rim is by no means new. This same idea has been previously tried, and even though found practical, has not met with very great approval.

There is one objection to the method as outlined, in that the flange slides over a portion of the rim. This is quite a poor method because rust or dirt getting in on this surface makes it almost impossible to separate the rim. The best method of approach is the system now used on the wheels of an automobile.

We are doubtful that you can do anything with the idea, and advise no further action.

VERTICALLY RISING PLANE

(1131) Henry Cloutier, New York City, has designed an airplane which he claims will rise vertically if perfect balance can be maintained. He asks our opinion.

A. 1. There are a great many inventions on the market along the lines of vertical rising airplanes, some of which have proven themselves to be highly satisfactory. If the airplane you have designed requires that it must be perfectly balanced at all times in order to give a good rise or in order to maintain equilibrium in the air, we would advise no further action. Perfect stability in any form of airplane will at all times be nonexistent, just the same as it will be impossible to ever develop a ship which can never roll or bob up and down on the waves.

RAINCOAT

(1132) William Girard, Lawrence, Mass., asks our opinion of a raincoat designed to prevent water getting on the feet of the wearer.

A. 1. We do not think that the suggestion for a raincoat back which you have designed is a very practical idea. In certain respects it reminds us of the invention of a raincoat which had a gutter at the bottom and a spout projecting from the side thereof to prevent the water from getting on the feet.

All this could be overcome by simply increasing the length of the raincoat or extending it at the base, making the coat act as a perfect shield for the feet.

We are doubtful that the ribbed construction will prevent wet feet.

SKID PREVENTER

(1133) Ernest Makonsky, Hoboken, N. J., has designed a system for preventing skidding of an automobile. His method consists of having arranged on a system of levers forms of wedges, which, by the operation of a controlling device, are driven beneath the wheels and in contact with the road. He intends in this way to prevent the skidding of an automobile by the increased frictional contact with the road.

A. 1. The method for stopping an automobile and for apparently preventing that automobile from skidding as indicated in your recent communication, is in our opinion entirely impractical. Inequalities in the road-bed prevent the particular blocks which you intend to suppress motion from making contact with the road and with the wheel. It is apparent then that if any one of these blocks does not properly create a friction on the road-bed, the tendency of the automobile to skid will be even greater than today. If a projection were to rise up from the road and encounter one of these blocks, the chance of a dangerous accident is more than possible. We certainly advise no action along this line.

PHONOGRAPHIC SIGNAL REPRODUCER

(1134) Joseph N. Labovsky, Wilmington, Del., asks our opinion of a "talking" horn to repeat any signal desired.

A. 1. Many years ago manufacturers made talking dolls and talking horns for automobiles. It seems that people do not care for devices of this nature, except as novelties. In the talking doll a drum record was used, having about ten lines of voice on this circular record. In the talking horns for automobiles, a metal record was used, which repeated the same thing over and over again.

HAIR CLIPPER

(1135) George Girard, Elmhurst, L. I., asks whether we think there is a market for a self-hair cutting system.

A. 1. There are many methods of cutting hair which the individual himself can employ. One of these consists of a safety blade attached directly to a comb and by combing the hair one can trim his own hair. The operation is smooth and simple. One-man hair clippers were also put on the market and many other means for giving oneself a hair cut have been tried, yet none of them have been even ordinarily successful. We certainly advise no action along this line.

TEMPERATURE WINDING CLOCK

(1136) Nathan H. Brachman, Dayton, Ohio, requests our information on a clock which shall be daily wound by changes in atmospheric temperature. He mentions no specific design, but wants to know if he can patent the system.

A. 1. There are, we believe, quite a few patents covering the mechanisms for automatically winding clocks by expansion of liquids (xylene generally employed) and by expansions of metallic bars.

SCIENCE & INVENTION Magazine many months ago illustrated a perpetual clock built in France, which had a piston operating within a cylinder, which piston wound up the clock through a rack arrangement. A far better method than this is the system utilized in the Motoco indoor-outdoor thermometer and in the distant temperature registering means. In these systems liquid is placed within a tube which connects directly with a coiled flat tube made of relatively thin material. Any pressure exerted in the liquid has a tendency to open this spirally-coiled tube. At the same time there is no leakage of pressure or loss of liquid. This system could easily be used to wind a clock spring.

We do not believe that a patent will be of any value whatever unless you can develop a satisfactory system.

GAS MOTOR VALVE

(1137) T. S. Dayton, Gilmore, Iowa, submitted an idea for a new form of valve for automobiles to be substituted for the present ports, which is in the form of a cylindrical tube and rotates to open and close the ports.

A. 1. The suggestion which you have advanced for an automobile valve is not new at all. A great many patents have been taken out on this same idea, and an engine employing this system has actually been built, tried, and found quite successful.

It is extremely doubtful that you could do any more with the idea than has already been done. We consequently advise no further action.

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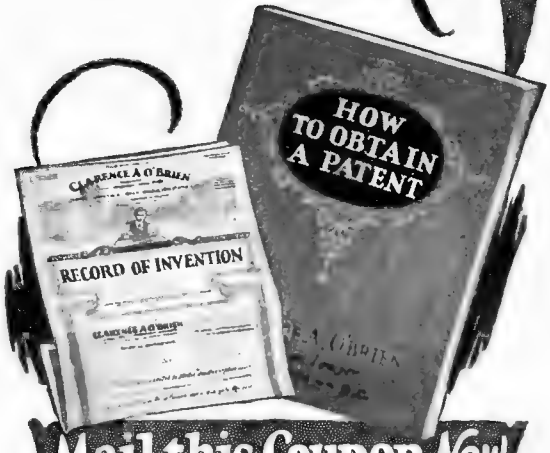

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Is Civilized Man Losing His Sense of Smell?

By UTHAI VINCENT WILCOX

(*Continued from page* 600)

"Smell," he stated, "seems to be the chief factor on which the social life of a bee colony is founded. A new hive odor is formed when colonies are united and the foreign hive odor is eliminated when queens are introduced. Knowledge of bee-odors helps in catching swarms. The absence or presence of the queen-odor helps to tell whether or not a colony is queenless and aids in locating lost queens."

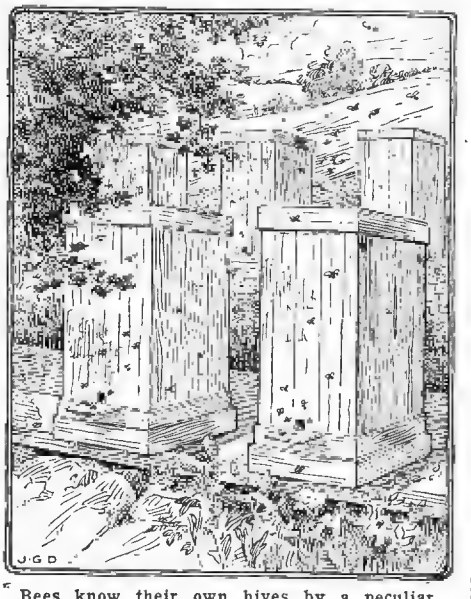
BEE'S KNEES

AFTER months spent in studying this insect, in the hives and under a high-powered microscope in his laboratory, Dr. McIndoo paused in his investigations to make this announcement to the scientific world:

"It's the bee's knees."

He was not trying to be funny. He had discovered that the olfactory glands, or, one might say, nose, of the bee are principally located in his knee joints. To the layman such detailed studies of the insect's sense of smell may seem pointless, but to the scientist and to the scientific farmer the findings are highly important, leading to the control of destructive pests and the consequent saving of millions of dollars. How this is accomplished will be explained later.

Pierre Loti, in *Madame Chrysantheme*, makes mention of "a strange odor, mingled with that of lotus and musk; an intimate odor of Japan, of the yellow race, which rises from the soil and emanates from ancient wainscotings." Another writer remarks that the different races have characteristic odors; that, while the African native has a disagreeable odor to the European, the European is still more offensive to Japanese nostrils. It is said that certain English people have been able to recognize, not only different races, but different persons by smell.



Bees know their own hives by a peculiar sense of smell. It is the bee's knees which give forth the characteristic odor.

Dr. McIndoo, pursuing his study of odors, has concluded that in civilized man the sense of smell is most highly developed in the blind, and cited the instance of a boy, James Mitchell, born deaf, dumb and blind, who depended chiefly upon this faculty

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for keeping in touch with the world. He readily observed the presence of a stranger in the room and formed his opinions of persons through this sense alone.

Another writer tells of an English acquaintance who declared that to her the odorous atmosphere of a person is as characteristic and unmistakable as the play of the features or the carriage of the figure.

A deaf, dumb and blind boy made his impression of various visitors dependent directly upon his sense of smell.

It is true that dogs identify people in this manner and even objects they have lightly touched. In view of this fact it is not difficult to imagine that a person, in whom the sense is acutely developed, might be able to do the same. The skin constantly exudes the products of body metabolism, the building up and breaking down of countless tiny cells, and these products differ in each individual, no two being alike, giving rise to various chemical odors.

Exploitation of the sense of smell and the classification and advancement of knowledge regarding it would result in the unfolding of a new world of experience and would prove of intense scientific and economic value, Dr. McIndoo believes. He points out that the senses of sight and hearing already have been made the subject of intricate investigation and that their stimuli, light waves and sound waves, have been accurately measured and analyzed. Intellectual curiosity regarding the nature of sound has resulted in the telegraph, telephone, microphone and radio; and, in light, in the microscope, telescope, photographic camera, moving picture machine, the discovery and use of ultra-violet rays and X-rays.

In spite of the fact that, as far as knowledge of the sense of smell is concerned, "we are still living in the Dark Ages," information that has been gleaned, and has been used to great advantage, Dr. McIndoo stated. Here are some instances:

HOW SOME MAKE USE OF SENSE OF SMELL

CHARACTERISTIC odors are associated with certain diseases, and the physician is using his nose as well as his eyes and ears in diagnosis. Chemists use the olfactory sense as a help in analysis; bacteriologists identify cultures by their odors, and plumbers use their sense of smell in locating leaks in boilers and pipe lines. The procedure in the latter case is to force through the pipes water or air that has been mixed with peppermint oil or wintergreen, then smell at the cracks and joints. Or catnip oil can be used and a kitten be delegated to do the sniffing.

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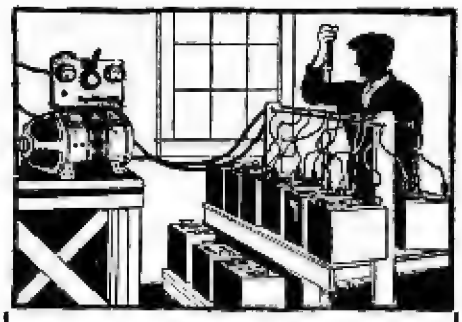

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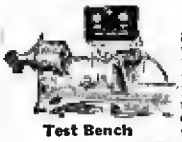

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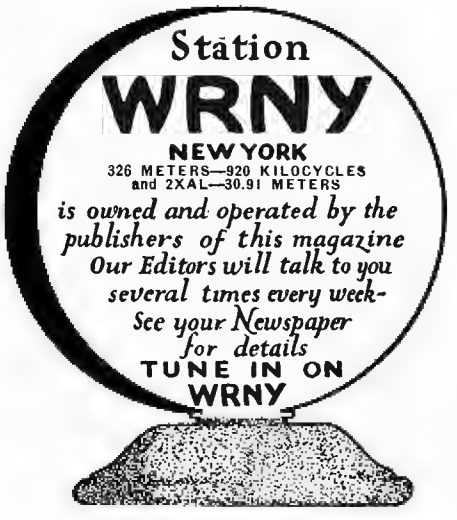
The scientist finds, moreover, that it is literally true that "our lives are often saved by our noses." The sense of smell, he explains, alone warns us against certain poisonous gases and manufacturers of illuminating gases, which are odorless, add odorous impurities to them, to decrease the danger of asphyxiation through carelessness. Other gases, not harmful in themselves, warn against dangerous conditions. Coal gas indicates the presence of deadly carbon monoxide, which has no odor, and sewer gas warns against unsanitary conditions which may menace health.

Next to the perfume industry, perhaps the most important practical application of smell is to be found in economic entomology, the control of insect pests through knowledge of their respective likes and dislikes in regard to odors. This knowledge has been gained haphazardly, by the laborious trial and error method, due principally to the fact that the insects' preferences are so different from those of a human being that the entomologist's own sensations cannot be followed as a guide. But once the odor has been found which allures the ant or locust or other insect, the scientist exploits it as a bait and mighty is the slaughter.

This method has proved effective to the extent of practically eradicating certain pests in various areas and has resulted in saving farmers millions of dollars in crops. In this work Dr. McIndoo has been a pioneer.



ODORS AS BAIT

AMONG insects which have responded to such poisoned baits are the Argentine ant, which in 1922 "took" the State of Mississippi; the grasshopper, against which war was declared in western Canada in 1921, with the result that 2,400,000 acres of crops were saved in one province alone; and the olive fly, worst enemy of Italy's great olive groves. Experiments are now in progress to find an odor which will attract the codling moth, which ruins apples, and the enormously devastating Japanese beetle.

Attractive baits have been successfuly employed even in controlling animal prey. A member of the U. S. Biological Survey, accidentally discovered that lions like the odor of catnip just as well as kittens, and oil of catnip has been effectively used to bait lynxes, bobcats and mountain lions in Western States, where they destroy, annually, livestock and game valued at from $20,000,000 to $30,000,000.

In view of the rapidly increasing value to science and industry of an accurate knowledge of odors and the sense of smell, Dr. McIndoo strongly urged greater cooperation among men in all branches of science to increase the fund of information.

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"GOOD work," he stated, "has been done, but not enough; and enough will not be done until there obtains a lively and wholesome curiosity about these two neglected senses, smell and taste, which in reality must be studied together.

"Consider what illuminating results are now available from researches in some of the other senses. To illustrate the comparative attention devoted to the different senses, one need only open the *Encyclopedia Britannica*. In the last edition, dated 1926, over thirty-two pages are devoted to sound, seventeen and a half to light, and four to touch, but only a page and a half each are given to smell and taste.

"The authors of this storehouse of knowledge have either carelessly overlooked the recent information on all the five special senses, except hearing in the heading "sound," or they consider it of too little merit to be published."

Dr. McIndoo is by no means the only scientist who has advocated research along these lines in the belief that studies would lead to the founding of a new science. Among others who have realized the importance of such work was the late Alexander Graham Bell, who said:

"Why not measure a smell? Can you measure the difference between one kind of smell and another? Until you can measure their likenesses and differences, you can have no science of odors. Find out what an odor is—whether it is an emanation, and therefore capable of being weighed, or a vibration, and therefore capable of being reflected. Odors are becoming more and more important in the world of scientific experiments and in medicine, and the need of more knowledge will bring more knowledge, as surely as the sun shines."

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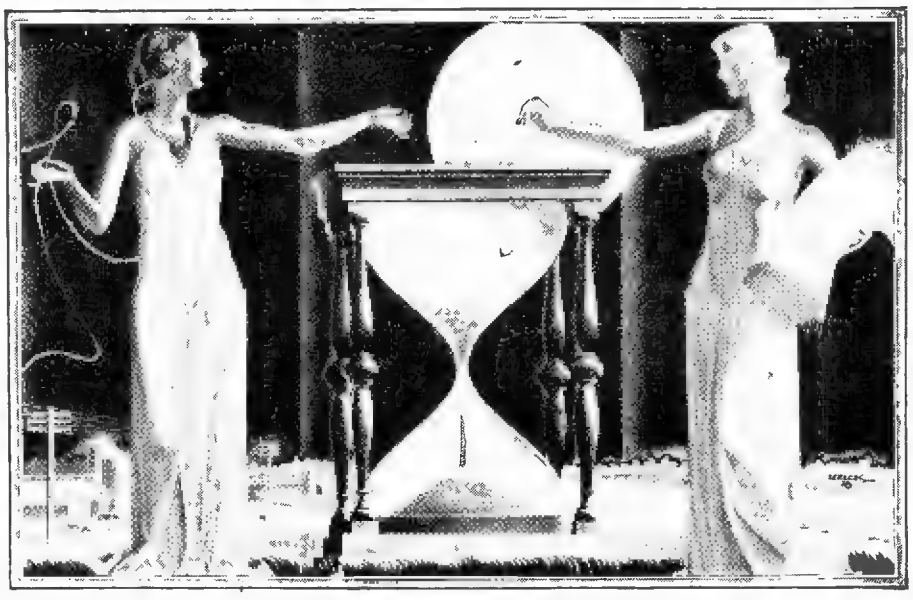

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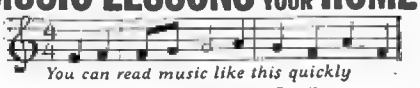
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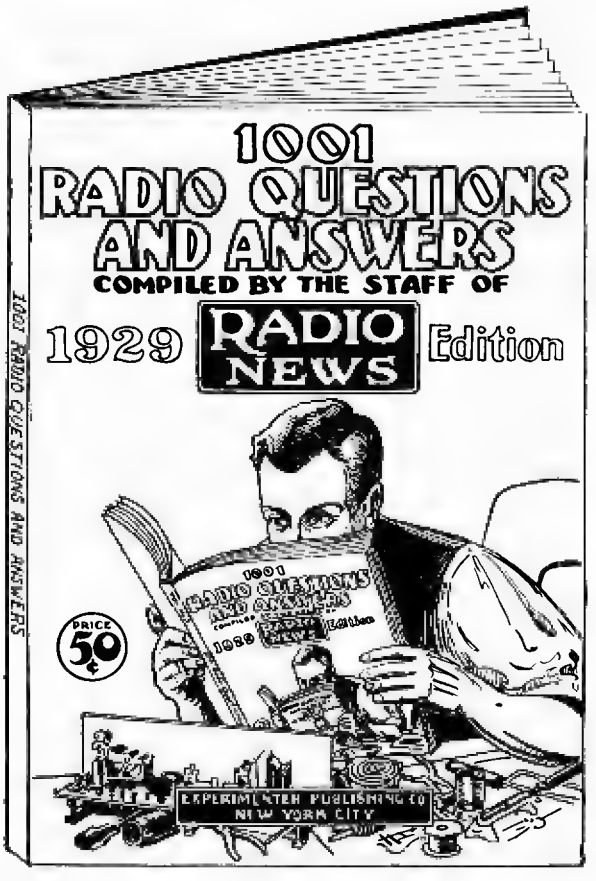

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PEAK LOAD

By E. G. MARTIN

(*Continued from page* 605)

flow of gas and maybe asphyxiating a dozen men before they were cleared; fire might break out and run riot through the plant. No matter, it was all a part of the day's work. But if the holder "hit the mud," that is, came down to rest upon the bottom of its tank, *that* was irrepairable disaster.

With no gas left to feed the whirling pumps which drove it out into the network of mains and service pipes, service stopped and thousands of phone calls poured into the office. All the effects of months of advertising and promotion work were destroyed in ten minutes. "The elephant never forgets"—and neither does the housewife whose dinner has been spoiled because "the stove won't work." Only once, in Matt Boyle's forty-two years of service, had the Homestead holder "hit the mud," and that was when floods covered the entire plant, and most of the city, with ten feet of swirling muddy water.

Matt found the water-gas house in complete chaos. The place was full of smoke and steam; broken glass and iron fragments covered the floor. Men ran about aimlessly, shouting to each other and prying in the piles of twisted sheet-iron and steel rods. Over in a corner, someone was screaming and Old Matt made his way there. He found two men trying to give first-aid to Joe Spinelli, the gas-maker's helper. One look at Spinelli's blistered face and fore-arms told him that the helper was through for a while.

Stokers just off duty were there, faces covered with coal dust until they looked like masks. The storekeeper was poking among the debris in search of something, entirely oblivious of soot falling on his white collar. Men from other departments crowded about the doors, looking on and calling to ask what had happened. There were even a couple of women, probably wives of plant-men, who had come after their husbands. They looked in with white, scared faces and shuddered at the screams of the injured man until an ambulance took him away.

The foreman emerged from a cloud of steam and Matt hailed him. "What is ut, Heck?" he shouted. "Where's Fred Ames?"

"Fred's sick at home." Barry answered

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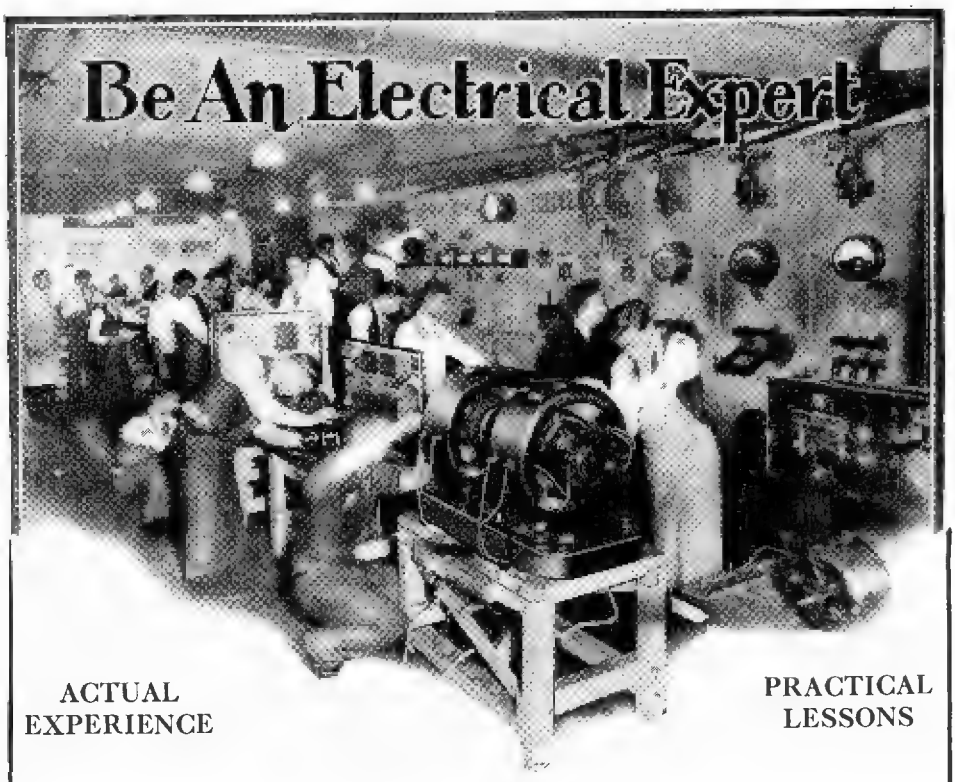

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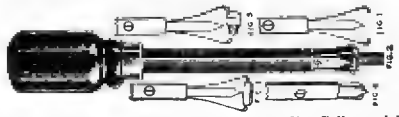

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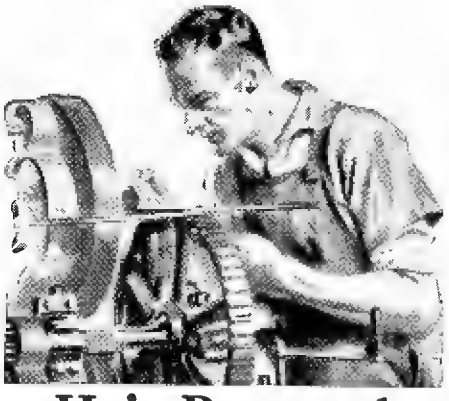

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shortly, "Joe was runnin' the machine, with a Mex. helper. What a mess! Blast-piping blowed to hellangone; checker-brick down maybe, holder half-full, an' only two hours to the peak-load."

The foreman hurried away, yelling to the repair gang. He didn't need to draw a diagram for Old Matt. The peak-load—when the restaurants would begin cooking, gas jets would be lighted in the dark rooms of tenements, and thousands of housewives would hurry home from the movies to start supper—was less than two hours away. There wasn't enough gas in the holder, plus whatever the coal-gas plant could make, to meet the demand. The holder would hit the mud and there'd be Hell to pay and no pitch hot.

Five minutes later, a car slid to a stop in front of the plant and the superintendent hurried in, looking for Barry. Haynes Todd was not a big man but he was a great one—to himself, at least. His clothes appeared to have just left the hands of an excellent tailor, and he carried his heavy shoulders and thick neck with all the military precision of a newly-made second lieutenant.

Todd was a fair-to-average super. He had theories, a few of them having to do with gas manufacture, but most of them devoted to sales promotion and civic betterment, anything that would help along the aggrandizement of Haynes Todd. He wasn't popular with his more grimy employees, but since he spent little time at the plant, wasn't especially unpopular either.

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Most of the shares of stocks for these perpetual motion machines are being sold at a rate of $1.00 per share, although some inventors are trying to sell shares of stock at $100.00 per share.

Therefore the editors of this publication say, "Just come in and show us—merely SHOW us—a working model of a perpetual motion machine and we will give you $5,000.00. But the machine must not be made to operate by tides, winds, waterpower, natural evaporation or humidity. It must be perpetual motion."

Matt Boyle edged closer as Barry reported to the super. "Gas leaked into the air-blast piping and blowed up," the foreman explained. "Repair gang say it will take four or five hours to get it back in shape. The checker-brick seem to be all right."

The super frowned importantly. "How long before they'll run?"

"Six hours, maybe eight—can't tell yet."

"How about the holder?" Todd demanded.

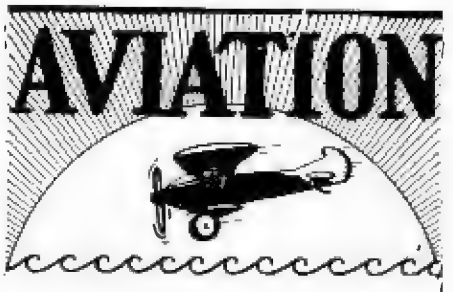
"Half-full, not near enough," Barry told him. "I'm gettin' a fire started in Number Ten."

"Number Ten!" Todd exclaimed. "That pile of junk? Will *it* run?"

"It's got to," Barry answered shortly. "It's not so bad, for all it's stood there seven or eight years without being used. The checker-brick are all in place and the auxiliaries are in fair shape. All she needs is an hour to warm up and a man to run her. That's the rub. She's hand-operated, you know, and with Ames sick an' Spinelli in the hospital, I'm the only one left that knows the job. An' I've gotta be in the retort-house making coal-gas."

"Oi'll run 'er!"

Barry whirled at the voice and saw Matt



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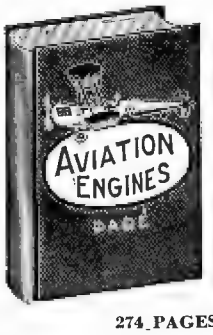

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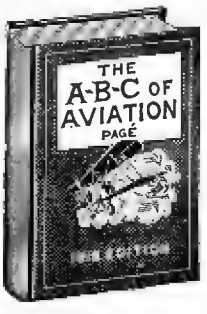

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Boyle shouldering his way closer. Well, why not? Matt had been a gas-maker once. In fact, he had been the one to start up old Number Ten for the first time, and run her when she was the newest thing in gas-making machinery.

"All right," he said. "Thanks, Matt."

They went to look over old Number Ten. She was built in three steel shells standing in a row. The first, ten feet in diameter and twenty feet high, was being filled with white-hot coke, fresh from the coal-gas retorts. This mass of incandescent fuel would be alternately blown to white heat by the air-blast and drenched with steam to form the blue, or "water" gas. This gas would be enriched by oil, sprayed upon the heated checker-brick in the other two shells and pass from them through washing and cooling processes to the holder.

Number Ten didn't look so bad, for all the paint was peeling from the steel shells and she was covered with dust. Matt Boyle climbed heavily up the stairs to the control platform above the shells. While Barry went after water for the old-fashioned gauges on the instrument panel, Old Matt moved methodically among his levers and valves. He swung open the fueling door and shaded his face with an arm as he peered down into the inferno below. He looked down through a glass-covered peep-hole at the checker-brick in the carburetor, noting that the brick was already beginning to glow. Number Ten had no thermostats; her operator had to judge temperatures by colors.

For a minute, Matt Boyle wondered why he had volunteered for this job. He certainly didn't owe the Homestead anything, and this wasn't going to be any picnic. Why not let the super burn his own fingers? Then he looked at the holder and forgot everything else. It was dropping—fast.

The hot-valves were rusted fast, but Matt found a short section of pipe and hammered them loose. Then he drenched them in oil until they moved freely. He inserted the oil nozzle and made the connections that allowed water to circulate through it and keep it from burning up. He climbed a short ladder to light the pilot flame at the stack and poured oil on the bearings of the heavy stack-valve. Last of all, he wound the clock.

The clock was important, for water-gas making is not a continuous process; it is done in cycles. Four minutes of air-blast heat the fuel to incandescence; steam and oil are sprayed in for six minutes of "make"; then the blast is started and air and gas together are forced through the machine for one minute of "purging." Then, do it all over again.

At 4:30, Number Ten went "on the line." Steam and smoke gushed from loose joints and dried-out valve boxes; oil pressure dropped continually as the wheezy pumps tried to keep up; but the relief holder, into which the gas was first blown, began to rise.

"Star-rt yer pumps!" Old Matt bellowed; and the exhausters which moved the gas from the relief tank to the main supply lines began to throb. It was time, too! The big holder was lower than he had ever seen it at this time of day; and the peak load had barely started. Matt turned to his levers and his clock.

The superintendent was walking nervously back and forth across the iron floor-plates, looking out of the window at the holder and getting in Matt's way until the white-haired old Irishman growled at him to keep out from under foot. Then he went downstairs to give orders and interfere with the work of the repair gang.

Barry had gone over to the coal-gas plant. Matt Boyle could see the stokers, their clothes smoking from the heat, pulling half-baked coke from the retorts to make room for new charges of coal. Others were throwing "guns," six-foot lengths of pipe filled

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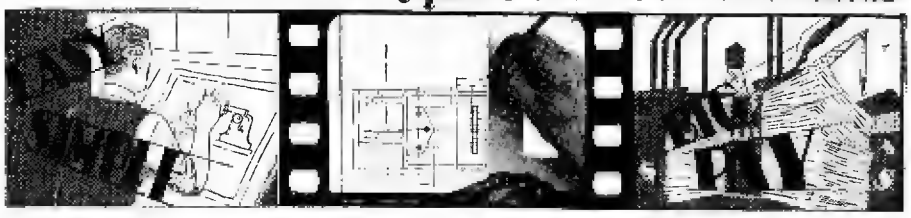

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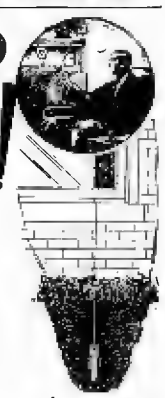

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with oil and stoppered with rags, into the retorts on top of the coal. This would make the gas richer and increase the amount made a little, not much.

From the other end of the building, a faint beating of hammers, barely audible above the din of old Number Ten's clattering auxiliaries, told Matt the repair gang were getting new blast-pipes into place. The automatic machines would be ready for action in a few hours, but that wouldn't do any good for tonight's peak-load. That was up to Old Matt, the man who was too old to work for the Homestead any longer, and to Number Ten, the "junk-pile," that had been left standing because it wasn't especially in the way.

After the next period of re-fueling, Matt took time to glance over at the holder. Jerusalem, my happy home! It was low! They were fairly on the peak now, it was 5:30, and half an hour to go before the maximum was reached and the demand began to drop off; an hour or more before they would be safe. Number Ten groaned and erupted smoke and steam from every crevice.

Those leaks worried Matt, not because of the smoke and steam but because of what went with them. One of the main constituents of water-gas is the deadly carbon monoxide, which steals up on a man and kills him before he even suspects its presence. The back of Matt's head was beginning to throb and the old-timer realized that his blood was filling up with something that wasn't going to do him any good. He ordered the helper to stay by the open window and went there himself as often as he could.

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Something went wrong down in the yard. Men were running with buckets and shouting. Matt couldn't hear what they were saying for the noise all around him, but he supposed they were calling for the foreman. Just like a bunch of Bohunks and Mexicans, he thought; run around and fall over themselves, and yell for somebody to come tell 'em what to do. He noticed that his relief holder was getting low.

"Speed up thim pumps!" he roared to the man below. The fellow yelled something back at him, but Matt couldn't hear. Then Barry arrived and two men went climbing up on the huge cylindrical tanks that were the purifiers.

"Box clogged," the foreman called up as he passed under Matt's window on his way back to the coal-gas plant. "By-passed 'er."

More gas lost, Matt reflected, and the purifier out of action. The gas would smell some, but that was better than losing the holder. He looked out again. The big tank was going down like an elevator. Pumps were dragging gas out of his relief holder as fast as he could put it in, but it didn't seem to make any difference.

He saw the foreman run out of a door and go up the ladder on the holder like a scorched monkey. Plainly, Barry was doing some worrying. Well, he had something to

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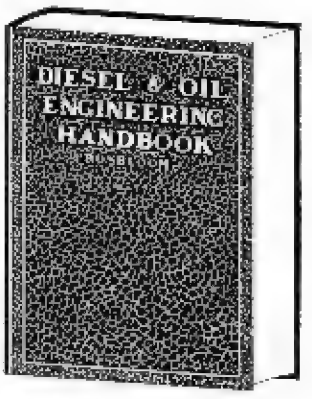

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worry about. The chances of stopping that downward rush were those of the proverbial celluloid cat. Todd was out in the yard, yelling up at the foreman and Barry was yelling back at the super. Matt couldn't hear what was said, but he could guess.

Matt wearily pulled back the throttle lever and the shrill scream of the blower died to a gentle hum. He swung his weight on another lever and the two hundred-pound stack-valve closed down. Then he twisted the handle of the steam valve and looked up at his oil gauge with eyes that refused to focus properly. The oil pressure was low, of course; he wouldn't get near enough in, this run—but it couldn't be helped.

Todd had disappeared. Probably the super had gone to warn the phone company. When that holder hit the mud, the telephone business was due to pick up. No use to put calls through to the Homestead office. Let the hello-girls tell the sad story.

Matt couldn't help a tingle of satisfaction. There'd be others worrying about their jobs—and they wouldn't be sixty years old, either. It would be tough on Barry, though. That stiff-necked Todd would pass the buck to the foreman. Or, if it missed him, it'd light on Spinelli. The little Wop had a wife and about seventeen kids—and him in hospital done up in picric acid bandages.

Another clamor of voices caught Matt's attention and he looked down the elevator wall. He groaned. That *did* finish it! The rickety old elevator, which had to carry a stream of fresh fuel to Number Ten was stuck. He caught sight of Haynes Todd and, beyond him, of Barry coming with a crow-bar.

"Don't pry ut!" Matt yelled. That was a temperamental elevator, always had been. An old-style hydraulic, pushed up on a piston from below, it had a habit of tilting sidewise in its guides and jamming. Matt remembered a time they'd tried to pry it loose and had to tear out all four guides to get it clear. What it needed now was a big screw-jack to set under it and give it a "hist." No time for that either, not now.

"Oh, Barry! Take 'er fer this run," he called. "Blast on, at 5:48."

Barry heard him, and ran up the ladder as Matt Boyle climbed down the guide to the platform. It was caught midway between floors and there was a steel buggy containing five hundred pounds of coke to be got rid of. Pushing it off would finish that buggy, but there was an extra one outside and Matt couldn't wait to build a runway. His fire was low now, and would have to have more fuel in the next ten minutes if Number Ten was to keep running.

"Git out the way!"

Bohunks scattered in all directions and Matt gave the coke-buggy a shove that dropped it on the floor, well out of the way. He climbed down and peered under the platform. As he expected, one corner was tilted down.

"T'ree av yez lift on thot edge," he called, and crawled into the pit himself.

"Come out of that!" Haynes Todd had completed his telephoning and was back on the job, giving fool orders as usual. "Don't you know that platform will mash you flat if it falls?"

Boyle paid no attention to the excited super. He was hunting for footholds, and found them—praise be! He got a shoulder against the platform and heaved. Nothing happened.

He strained again, and the laborers outside lifted with him. That platform might have been built solid with the guides, for all the move it made.

"Howly Pathrick help me!" Matt whispered between clenched jaws.

Whether the good Saint lent a hand or the thews and sinews of Buck Boyle that was, lived again for that minute in Old Matt's trembling body, doesn't matter. The

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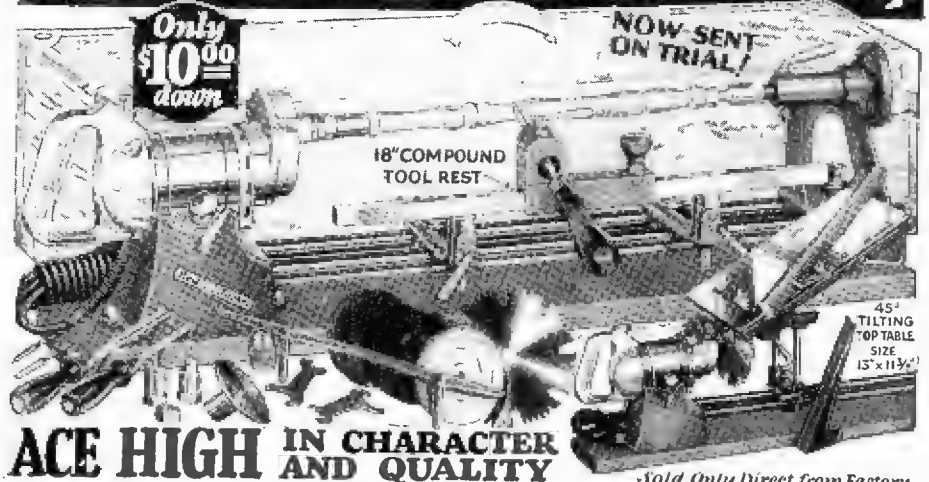

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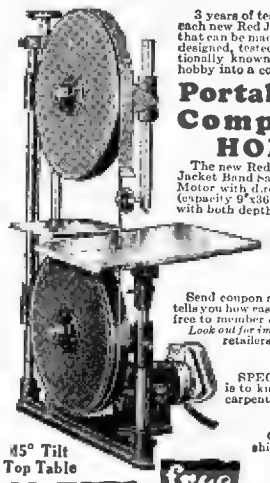

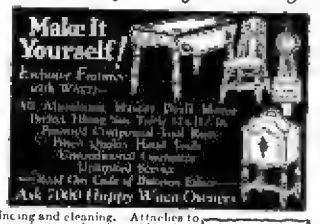

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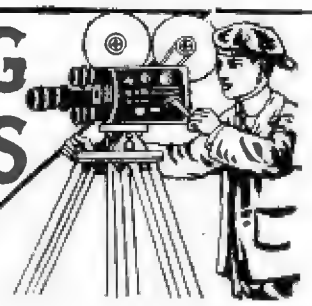

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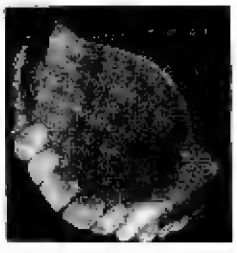

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platform moved! It rose an inch, quivered—slid easily upward.

"Fill thot other buggy," Matt shouted to his helper, and hurried back to relieve Barry. His first glance was for the holder. It was still visible above the rim of the tank. Then he looked at the clock—6:10.

"Praise the Saints!" he said.

Barry grinned. "Yeah, she's safe. All we gotta do is hold her."

At eight o'clock, the coal-gas plant caught up with the demand and they shut down Number Ten. It was time, for a blower bearing was white-hot and she was leaking more gas than she was sending into the relief holder.

Matt Boyle, with a raging headache but otherwise pretty chipper for a man past sixty, was sitting on a work-bench watching the repair gang test the new blast-piping. The holder was safe now, going up like a sky-rocket, Barry said.

The super found him there. Matt Boyle and old Number Ten had just saved Mr. Todd from a disgrace which would have followed him as long as he stayed in the gas business. And the super knew it. Moreover, there had been given to Haynes Todd in those moments of stress to glimpse something of the blind fealty to an idea that animated such men as Matt Boyle. He was a little awed, a little ashamed, so that he spoke almost diffidently.

"All right now, Matt?" he asked. "You know how I feel about what you've just done—on top of everything else. I'm going to take up your case with the directors tomorrow; an exception to their retirement rule won't hurt them. You're too good a man to lose."

Old Matt shook his head. Strangely enough, all bitterness toward the super had vanished. After all, Todd was doing the best he could for the company, just as they all were. But Matt felt old, tired of black smoke and the odor of tar and ammonia. It would be nice to have green things growing around him—to sit on a vine-covered porch and smoke his old clay.

"Don't do ut, Mister Todd," he said slowly. "Oi'm plannin' t' buy me a bit av ground an' raise me a flock o' bur-ruds. Ut's toime Oi was restin' a bit." He grinned suddenly, understandingly, at the super. "Ut's your job now, Sorr, t' kape her outa the mud."

$31,000.00 FOR SPIRITS

$1,000.00 was offered by this publication in the June, 1923, issue for spirit manifestations that could not be duplicated or explained by scientific means.

$10,000.00 for spiritual phenomena was offered through SCIENCE AND INVENTION by Joseph F. Rinn in the August, 1923, issue.

$10,000.00 was offered through SCIENCE AND INVENTION Magazine by Joseph Dunninger for spiritual manifestations which he could not explain or duplicate by scientific means under identical conditions.

$10,000.00 is now offered through this publication by Mrs. Houdini for the ten-word message which Houdini promised to deliver.

TOTAL: $31,000.00 for spirit manifestations.

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A section in which the latest developments of television are reviewed each month. This comparatively new industry is fast gaining popularity. It opens a new field for experimenting to our friend, the "fan."

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Wherein all new radio apparatus is fully described and its use explained. This section is especially valuable to set builders.

THE RADIO BEGINNER

As its name signifies, this section is devoted to the radio beginner. All the elementary principles of radio are discussed and full constructional data for the simpler sets given. Full-sized blue prints of the circuits treated are FREE.

RADIO WRINKLES

This department contains many suggestions helpful to the radio enthusiasts. Each contribution published entitles the author to a year's subscription to RADIO NEWS or, in cases where he is already a subscriber, a year's subscription to either SCIENCE AND INVENTION or AMAZING STORIES.

RADIOTICS

A humorous page of misprints contributed by our readers. For each one published $1.00 will be paid, provided that the actual article in which the misprint occurs is enclosed with a few humorous words from the reader.

RADIO NEWS LABORATORIES

In this section all apparatus awarded the RADIO NEWS LABORATORY CERTIFICATE OF MERIT in the month past is listed, and a technical description given of its purpose and characteristics.

I WANT TO KNOW

This department is conducted by Mr. C. W. Palmer. Its purpose is to answer the difficulties of our readers. The value in which the "fans" hold this section can be better realized when one considers that there are over 5,000 letters received from readers each month. Naturally only the more important ones are printed in RADIO NEWS.

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READERS FORUM

(*Continued from page 617*)

Then slowly as it came into its orbit and approached the sun, the ice upon its surface melted, leaving it covered with water. In this water generation was going on, every atom and substance in the water came together, and the combination made a germ; the germs made something else and so on until the water was infested with beings of all kinds.

Some of the beings lived upon their own species by killing them, and so these beings learned to protect themselves. As time passd they became more intelligent, some of them developing great intelligence.

I do not believe man derived from the monkeys, but I do believe he derived from these intelligent beings who fought for their place on the earth's crust. From the preceding theory we derived from the water atoms and molecules.

Water is our life-preserving food. When it is gone then we shall perish because the clouds will be no more and the sun's heat will beat down upon the surface as it does upon the deserts today.

I should like to be the last man on earth, gasping for breath; I believe I would not be far wrong in what I have written.

If this earth was to have been created before the universe, how is it that astronomers claim that there are bodies in the universe that are much more aged than the world. Perhaps the astronomers are wrong. I do not think so.

Generation is generation the world over, and where there is not a male or female substance, there is a positive and a negative. These brought together—something is the result. This world is it.

A. R. CANN,
Victoria, B. C., Canada.

(We do not believe it possible that this earth was at one time a part of the crust that was on the sun. As a matter of fact there is no proof or indication that the sun ever had a crust. The sun was probably in a nebulous state at one time and gradually became more and more constricted. This earth also may have been a sun millions and millions of years ago. In traveling through the universe it was probably captured by the sun and in the course of this capture, either the moon was thrown off or the moon was previously captured by the earth.

There is no indication that germs are made from atoms and substances in water coming together. Spontaneous development of life is one of the theories still adhered to by scientists. Others believe that life on this planet came from another planet in the universe. There is a fair indication of proof that organisms entirely unknown to us have been discovered in meteoric bodies and that these organisms have been actually developed.

There is also a fair indication that this earth was never all water. While water did recede here and there, land also piled up in other places. Some parts of this earth had glacial drifts, others had none.

It is also the consensus of opinion that while man did not come from a monkey he was derived from a stock of which the monkey is also a descendent.

Inasmuch as nobody knows how much water there was on this earth a thousand years ago, it is impossible to predict that a time will come, when, eventually there will be no living beings upon the earth. In the course of these evolutionary changes it is possible that man will also so evolute that he can do with practically no water.

No astrologist ever stated that this earth was created before the universe, such a thing is impossible, because this earth forms a part of the universe. There is no theory for the creation of the universe, its size or its age. These things are even beyond the scope of the imagination.

You stated that "A generation is a generation the world over, and where it is not a male or a female, it is a negative or a positive." Here your statement is incorrect. In the amoeba, in the paramecium, in the diatom, and other one-celled plant or animal life there is no positive or negative; no male and female. When the animal gets larger, its body merely splits in two and the result is that we have a new generation. Both the parent and the portion thereof that was split off become revived by this process, and life goes on as with two newly born. No positive or negative—just a simple mystery—EDITOR.)

Must Men Suffer *after 40?*

A well-known scientist's new book about old age reveals facts which to many men will be amazing. Did you know that two-thirds of all men past middle age are said to have a certain seldom mentioned disorder? Do you know the frequent cause of this decline in vitality?

Common "Old Age" Symptoms

Medical men know this condition as hypertrophy of the prostate gland. Science now reveals that this swollen gland—painless in itself—not only often cheats men of vitality, but also bears on the bladder and is often directly responsible for sciatica, backache, pains in the legs and feet and dizziness. When allowed to run on it is frequently the cause of cystitis, severe bladder inflammation.

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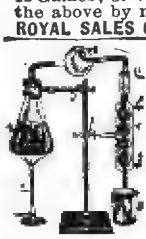

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Electrical contractors, wholesalers, retailers and buyers of electrical goods, and all others engaged in the business of distributing and supplying electrical appliances throughout the United States, will have their own trade show in New York City in October, where assembled in one place they may see exhibited and demonstrated the thousands of approved electrical devices used in the modern home and meet face to face the manufacturers or their representatives.

This will be the first electrical trade show ever held anywhere, and it will be nation-wide in scope. It will be held on October 17, 18 and 19 in the Grand Central Palace.

Arthur Williams, vice-president in charge of commercial relations of The New York Edison Company and president of the Electrical and Industrial Exposition, who made the announcement of the trade show, explained that the trade show is an expansion on a national basis of the annual electrical show, with the first three days set apart exclusively for the trade, and the final seven days open to the general or consuming public. The decision to expand the annual electrical show into a trade show on a national basis was made in response to recommendations and suggestions from important factors in the electrical industry, he said.

IN "RADIO NEWS" FOR NOVEMBER

Special Television and "Radio-Movie" articles—"Stereotelevision."

How to Build Your Television Receiver—a Blueprint Article.

The "Pre-Selector"—a Blueprint Article, by S. Gordon Taylor.

The "Magnetic-Striction Oscillator"—with Constructional Data.

And many other practical articles on radio construction, short-wave reception, new radio apparatus, and radio theory.

Food Adulteration

(*Continued from page* 611)

side of the spoon. Renovated butter (and also oleomargarine) on the other hand, will boil noisily, sputtering, and acting like a mixture of grease and water, but will yield little or no foam. The difference in the amounts of froth or foam is very marked, and acts as a conclusive test as to the nature of the butter.

To distinguish between oleomargarine and either fresh butter or the renovated variety, pour about a cupful of milk in a wide-mouthed bottle, and place in a vessel of boiling water. Add a spoonful of the butter to the heated milk, and stir to melt it. Then remove the bottle and place in ice-water, stirring thoroughly until the butter hardens. If the solid fat is in a granular condition, and scattered throughout the milk in small particles, then it is butter. If, on the other hand, the fat congeals into one solid lump, so that it may be removed bodily by the stirrer, then it is oleomargarine.

SOME ADULTERANTS IN MEAT

As every housewife and every food handler knows, one of the most perishable of all articles of our diet is meat. This fact may be attributed to the presence in the meat of all of the conditions that are favorable for the growth and development of decay bacteria. To arrest this rapid spoiling, various chemical preservatives are used, such as boric acid, benzoate of sodium, salicylic acid and sulphurous acid. Their

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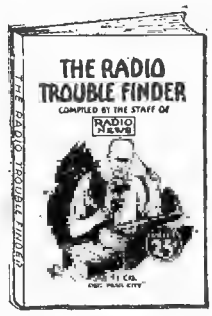

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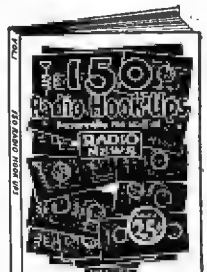

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detection involves the use of several more or less common reagents.

As a preservative for mince meat, catsup, jams and fruit jellies, benzoic acid, or its salt, benzoate of sodium, is most widely used. To recognize its presence in meat, rub the sample with water and acidify with hydrochloric acid. Set the mixture aside in an evaporating dish near a radiator or other warm spot, cover from dust and allow

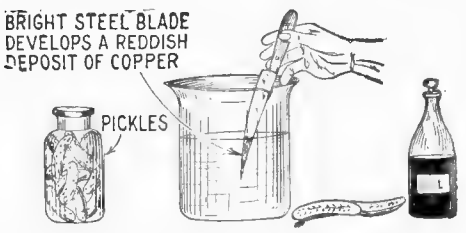

Fig. 5. If your pickles appear to have a suspiciously vivid green color, this test will tell if it is due to poisonous copper salts.

to stand for a few days, so that the solution evaporates slowly. Beautiful crystals of benzoic acid are formed, sometimes growing up to a height of one-half inch. If the amount of benzoate is small, extract by acidifying and shaking with chloroform, and set aside to evaporate slowly. The result is the formation of benzoic acid crystals as above.

To test for boric acid or borax, frequently found as a preservative in sausage, butter and milk, we use turmeric paper, made by cutting filter paper into strips, dipping into tincture of turmeric, and drying. It is on sale in the chemical supply stores. Rub the meat thoroughly with water and filter to remove the solid part. Add five drops of hydrochloric acid, dip a strip of turmeric paper into the liquid, remove, and warm over a Bunsen burner. The formation of a bright, almost cherry-red color on drying shows boric acid or borax. Pour one drop of ammonia on the paper, and the color changes to dark green or greenish black.

Sulphides are sometimes employed to "doctor up" sausage and chopped meat. The test for this adulterant is simple. Macerate the sample with water, add several pieces of pure zinc and about five c.c. of hydrochloric acid. If sulphides are present, hydrogen sulphide will be liberated, which will readily be recognized by its characteristic "rotten egg" odor. To confirm the test, dip a piece of filter paper into a solution of lead acetate, and suspend over the mixture. A black or brown coloration on the paper indicates the presence of hydrogen sulphide.

ARE "DYED" FOODS HARMFUL?

THERE is another method of falsifying food, and making it appear better than it is, or of simulating wholesome foods with a combination of entirely foreign substances. The coal-tar dyes, of which there is an end-

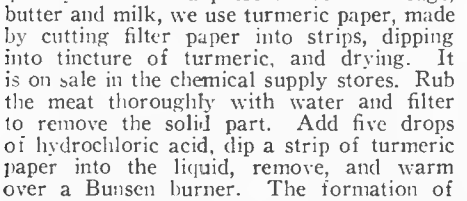

Fig. 6. You may distinguish the pure from the adulterated coffee, by observing its behavior in cold water.

less variety, lend themselves very readily to the coloring of foods and beverages. There is considerable difference of opinion among food scientists whether all the materials used for coloring foods are injurious to the body. But there is little doubt in regard to the effect of many of these dyes,

(*Continued on page* 657)

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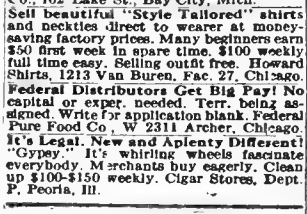

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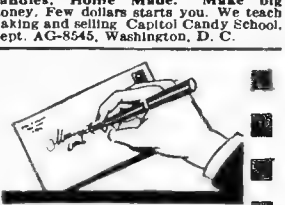

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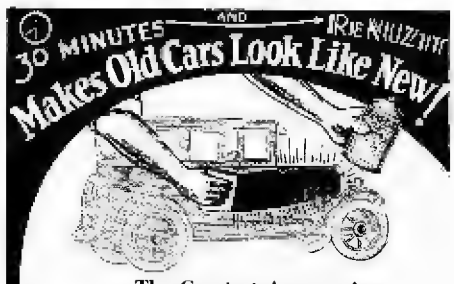

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Food Adulteration

(*Continued from page* 655)

as they are known to be harmful. The U. S. Department of Agriculture, after a careful examination, has approved of the use of eight aniline, or coal-tar colors, which are known as "certified dyes." However, the use of even these approved materials may constitute a fraud, if they are employed to give a false appearance to the foods containing them. Coloring matter may be added to jams and jellies made from inferior substances, so as to give them the same appearance as those made from fresh fruits. Dyes may be added to tomato catsup and pickles to restore the original color which has been lost in the process of canning. Artificial coloring matter is often added to butter. Frequently chopped meats which are no longer fresh may be treated with a red dye to give them the appearance of fresh meat.

To test fruit products, as well as any other foods, for artificial coloring matter heat a small quantity in boiling with water. Place in this liquid a small woolen cloth. Boil for five to ten minutes, stirring occasionally. Remove the cloth and wash in hot water. If the cloth is brightly colored, the presence of artificial dyes is shown. Natural colors give a dull, pinkish brown tinge.

While on the subject of artificial coloring materials, it is interesting to note that salts of copper are sometimes used to impart an intense green hue to imitate the natural green as in peas, green beans, brussels sprouts and pickles. Since copper salts are highly poisonous, the danger in this form of adulteration is readily seen. To prove the presence of this adulterant add one or two drops of hydrochloric acid, mix thoroughly, and place a bright steel object, such as a knife blade, into the solution. A reddish deposit of copper will indicate that salts of that metal have been used in the food. Or filter off the solid and add ammonia to the liquid. A bright blue color indicates copper. Cheese cloth will answer for filtering through.

As a thickening agent in cheap jellies starch is sometimes used. Dissolve a sample in water, heat to boiling, and add potassium permanganate solution, drop by drop, stirring constantly until the solution is almost colorless. Cool the liquid completely and add a drop or two of iodine. The characteristic blue color proves that starch is present.

Saccharin acts slightly as a preservative, but more especially as a sweetening agent, having about five hundred times the sweetening power of cane sugar. In many states its use is prohibited by law, on the ground that it takes the place of sugar which is a valuable nutrient, and that it may have an injurious effect on the system if taken continuously. This adulterant is tested for as follows:—Mix the jam with water to form a solution, and shake with a small quantity of chloroform. The latter, which dissolves the saccharin and not the sugar, settles to the bottom and is removed by means of a medicine dropper. Evaporate the chloroform solution by gentle heat. The distinct sweet taste of the residue proves that saccharin was used in the food.

Another sugar substitute used in jams, jellies and candies is glucose, which is tested for in the following manner:—Mix the food with water, warm the solution, filter and cool. Add an equal volume of strong alcohol. If pure sugar was used there will be little or no precipitate. If glucose is present a dense white precipitate of dextrin forms, which settles to the bottom after a time.

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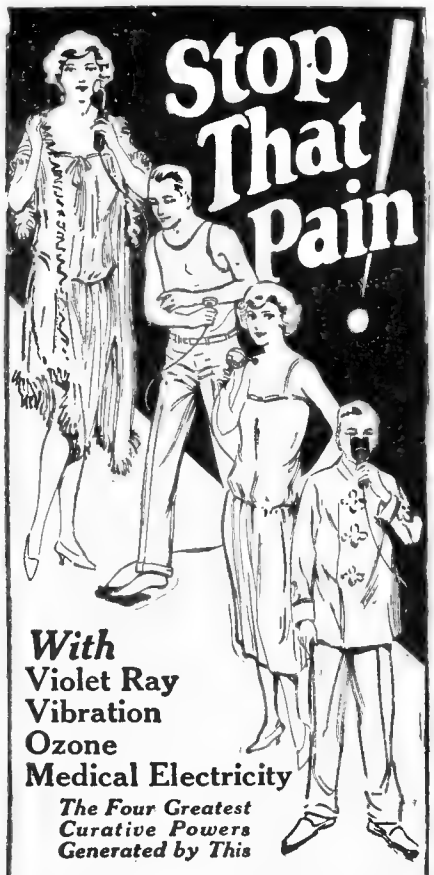

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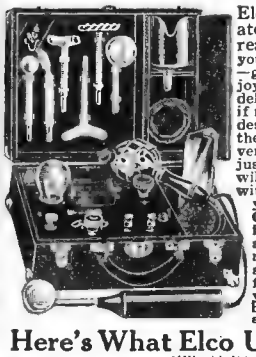

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VANILLA EXTRACT MINUS THE VANILLA

AMONG the flavoring extracts, that of vanilla and lemon are most extensively used. In the case of the first, a large proportion of the extracts on the market are not made from the vanilla bean at all, but from artificial vanillin and coumarin, with some coloring matter and sugar, added to a weak solution of the Tonka bean. The test consists of evaporating down some of the extract on a water bath to about half its volume. Add cold water to make up the original amount. By this treatment the alcohol of the extract will be driven off, and in the watery solution that is left the substances in true vanilla are nearly insoluble, so that the liquid will be cloudy, and have a dirty brownish color. The artificial extract, on the other hand, will be bright and clear.

As an adulterant, to imitate the natural color in flavoring extracts, caramel is frequently used. It is also commonly employed wherever it is desired to produce a red or brownish color in foods. It is made by heating sugar to a high temperature, which results in a partial decomposition, and a loss of most of its sweet taste and its solubility. In testing for caramel, choose two test-tubes of equal size, and put a sample of the extract in each. Add one teaspoonful of Fuller's earth (obtainable at your drug store) to one tube, shake thoroughly for several minutes, and filter. Compare the filtrate with the untreated sample. If a large part of the color is lost, it proves that caramel is present, since Fuller's earth has the property of removing this material.

Lemon extract is made by dissolving oil of lemon in strong alcohol. On dilution the oil is precipitated to produce a milky appearance in the liquid. To test, mix one part of extract with three parts of water. If real lemon oil is present it will be thrown out of solution, and will give the liquid a turbid appearance. Later the oil will form a layer on top of the water. If the solution remains clear after diluting with water, very little or no oil of lemon is present.

MISCELLANEOUS ADULTERANTS

A FORM of adulteration which is commonly practiced is the addition of foreign material to ground coffee, such substances being employed as chicory, caramel, peas and roasted grains as corn, wheat and rye. A simple method of detection is to shake the sample with cold water and let it settle. Pure coffee contains a large amount of oil, therefore most of the particles will float. Nearly all coffee substitutes are heavier than water, and sink, carrying along some of the real coffee, and coloring the water with a brownish tinge. If there is a large deposit of sediment, the coffee is adulterated. Since coffee contains no starch, while the cereal and legume adulterants (as corn, peas and beans) have large quantities of this nutrient, a chemical test may also be performed. Boil the coffee with water for two or three minutes. Filter, cool completely, and add a drop of iodine. The well-known deep blue color will indicate the presence of a starchy adulterant.

Cotton seed oil may be found mixed with olive oil in more or less considerable quantities, although the ease with which this foreign material may be detected has discouraged its widespread use. To test, use Halphen's reagent which can be obtained already mixed, or can be prepared very easily as follows:—Dissolve one-third of a teaspoonful of finely divided sulphur in three or four ounces of carbon bisulphide and mix with an equal volume of fusel oil (amyl alcohol). This reagent should be handled with great care because it is highly inflammable. To some of the oil to be examined add an equal volume of the reagent in a test tube and heat carefully for fifteen minutes in a vessel of boiling salt solution,

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consisting of a tablespoonful of salt in a pint of water. If there is even a small percentage of cotton seed oil, a distinct reddish color will appear. If the sample is all or nearly all cotton seed oil, the resulting color will be a deep red.

TESTING CANNED FOODS

A TREATISE on food adulteration is not complete without a passing reference to the subject of canned goods and the foreign matter which, accidentally or otherwise, may find its way into the foods. The process of food preservation by canning, or protecting from air and sterilizing, has developed to an enormous extent in this country. Fortunately, most of the food is prepared in such a way as to be entirely wholesome. Occasionally we find a can, the contents of which have begun to spoil or ferment, with the generation of gases, and a consequent swelling or bulging of the can. Formerly it was not an uncommon practice for manufacturers to puncture these "swells," and reheat them to stop fermentation, and afterward solder them again, and put them on the market.

It is not unusual to find salts of tin, iron and lead in canned products, due to the action of the acid fruits on the tin plate of which the can is composed. To show the presence of iron in canned fruit, test some of the juice from an old can of fruit with a little of a strong infusion of tea. Since the tea contains tannic acid, it will form a black coloration (which is nothing more than INK!) with the iron that has been dissolved from the tin plate by the acid of the fruit.

With a fundamental understanding of the nature of some common food adulterations, and with the inquisitive mind of a scientist and experimenter, the amateur chemist has before him a romantic as well as highly instructive field of research. Dozens of foods and food products that are used daily in the home may contain some foreign elements that are likely to be injurious to the health. Or, if the danger be not so serious, the adulterated food may still be an inferior product for which he is paying the higher price of the genuine article. Whichever the case, the ambitious home experimenter will derive more than a supercial profit from an application of these fairly elementary tests for food adulterants.

Danger—High Vacuum

(*Continued from page* 601)

almost complete collapse. The steam had condensed, forming a partial vacuum, and the outside air pressure had simply forced in the sides.

Michael Faraday, the inventor of the dynamo, many years ago performed a simple experiment before one of his lecture classes. He placed a thin tin vessel, containing a small amount of water, and equipped with a stop-cock, over a flame. Raising the water to the boiling point, he allowed it to generate steam until the steam had driven out what air was originally in the vessel. He then closed the stop-cock and removed the flame from beneath the vessel. In a few moments the steam remaining in the vessel had condensed and the light metal was crumpled as by a giant hand. Sir Wm. Bragg, the noted English physicist, shows the same experiment in photos in his popular book, "Concerning the Nature of Things." Thus, on the laboratory scale, we have an exact reproduction of what happened in the case of the larger and more strongly constructed cream can.

But even a well-built cream can, constructed for rough handling and general

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abuse, might just as well have been made of paper for all its strength as compared to that of the air. Everyone knows that air exerts about fifteen pounds pressure per square inch on the surface of the earth and upon every living and inanimate thing upon the earth. But for a like pressure exerted outwardly from within our bodies, we would be crushed by these mighty forces. If the cream can shown, had of been submerged in five feet o fmolten iron (and some means provided to keep it from melting) the pressure would have been about equal to that exerted by the air, and the can would have been crumpled in a like manner. Or weighted down in thirty-five feet of water the pressure would have been the same.

A few simple figures and one finds that the can was submitted to nearly eight tons of pressure, more than one wheel of a huge motor truck would exert if it were to run over it. In the drawing, the cream can is shown standing on end, with five feet of solid iron resting on the upturned base. If a like amount could be made to force in from the sides, we would then have a very fine parallel to that made by the weight of the air. It is this play of air pressure, both above and below the normal of fifteen pounds to the square inch, which makes high-altitude flying and deep-sea diving so dangerous.

Entertaining with Hypnosis

(*Continued from page* 593)

By KENA MURAY

suggestion that he is falling backward.

The quickest method of accomplishing this is to have the spectator stand erect, feet together and hands at the sides. Instruct him to make the body rigid, especially the knees downward. Close his eyes, and clearly suggest that you are placing your hand on the back of his neck and that when it is slowly removed, he will feel himself drawn back by an irresistible power and that he will fall backward into your arms.

Before the hand is slowly removed, you should suggest continually, that the subject is falling backward, backward, backward; when the hand is withdrawn, the subject will slowly fall backwards, to be caught in your arms before he reaches the floor. Again note that spectator is not asleep, but realizes everything that is happening.

SPECTATOR CANNOT UNCLASP HIS HANDS

THIS experiment is always a laugh provoking one and simple of accomplishment. The spectator stands directly before you, and clasps the hands tightly together, the fingers of one hand lacing with those of the other hand. Grasp the two hands and press them together firmly, especially so where the wrists meet, at the same time positively asserting that his hands are glued tight together and that, try as hard as he wishes, it will be found impossible to get them to come apart. Say, *now, try hard to get your hands apart—try hard! and see how impossible it is—the more you try, the tighter they get!* Snapping the fingers releases the spectator from this suggestion. The ridiculous movements which the subject goes through in endeavoring to free his hands is always a source of much laughter.

AUTOMATIC MOVEMENTS

BY the above is meant that a suggestion is given for certain movements to be performed continuously. Commence with the spectator standing erect, eyes on his two forefingers which should be pointed so that they touch at the tips in front of the body. Instruct subject to revolve each finger around the other, assisting with your own hands if he does not grasp your meaning instantly.

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STIFFENING SPECTATOR'S ARM OR LEG

IN this experiment the spectator should be sitting. Gaze into his eyes to keep his attention on what you say, and with the right hand seize an arm or leg and state clearly *notice that your arm is getting stiff, that it is like a board, that you cannot move it no matter how hard you try.* At the same time, draw the left hand over the arm to emphasize the meaning. The subject will go through many contortions in order to move the stiff member, but it remains in the rigid condition until you release him by snapping the fingers and calling *allright.*

TRICKS OF THE HYPNOTISTS

PERFORMERS who professionally use hypnotism for entertainment, and use and understand the eight or more different sleep and waking stages, use the name Hypnotism, from the Greek, meaning to *sleep.* As in every line of endeavor, however, there are self-styled hypnotists who apparently know nothing about the genuine science of psychology, and rather prefer to simulate hypnotism by the employment of trained subjects, who are known as *plants.* Many times the non-genuine hypnotist is known to hire subjects locally at a dollar or so a head, before the performance, with the understanding that they are to do exactly as the performer instructs them.

Have you become a "HOME MOVIE" fan yet?
Turn to page 608

Fake hypnotists are to be pitied, rather than criticized, for their lack of knowledge; yet, the "tricks of the trade" which they employ will prove interesting to the reader.

THE WINDOW SLEEPING TEST

IN genuine hypnotism, this is accomplished by suggestion. For advertising purposes, the subject is placed in the *lethargic* stage of sleep, and lies in a store window for twenty-four hours, to be later awakened on the stage of the theatre.

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THE CATALEPTIC TEST

WE are all familiar with the test wherein the subject is made rigid, like a board, and suspended between two chairs, the feet on the back of one and the head on the back of the other.

With rigid training and practice, practically anyone can duplicate this feat without the aid of hypnotism. Of course, by employing hypnotism, the genuine subject is enabled to undergo such tests as allowing several heavy people to walk on him while he is suspended between the two chairs,

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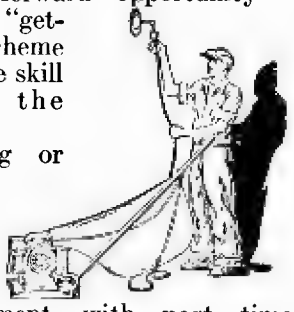

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or of having rocks broken on his stomach while in this condition. Both can also be done without this aid because some "plants" are even able to support a human being on their stomachs while between two chairs, without losing any of their rigidity.

THE BLOOD TEST

A GENUINE subject, who has been genuinely put to sleep a number of times, can be made through suggestion to contract the muscles of either arm so that the muscle pressure causes all of the blood to leave the arm, leaving it perfectly chalk white, and allowing the blood to return to the arm at the will of the hypnotist.

Like the other genuine experiments, this is also imitated. The non-genuine subjects sits sideways on a chair, with an arm over the back of the chair. He clenches the fist and contracts the muscles of the arm as much as possible to drive the blood black into the body, and at the same time presses the inner side of the arm against the chair back, causing the blood artery there to be closed by pressure. When the fist is opened, it is naturally white and bloodless, and when the pressure is released from the artery the blood naturally instantly rushes back, coloring the previously white arm a deep rose. This is a simple test than can be accomplished by anyone, although of course it cannot compare with the effect obtained when genuine suggestion or hypnotism are employed.

THE PAIN TEST

IT is well known that under hypnosis, any part of the body can be made immune from pain. Hypnosis has been used frequently for minor and sometimes major operations in hospitals without the use of ether or chloroform, as it leaves no bad after effects and the rapidness of recovery is remarkable.

In faking this, countless small tricks and subterfuges are used. Sometimes a long needle is prepared by cutting it in two in the centre and soldering to the separated ends a piece of flesh-colored wire that half encircles the arm, and gives the impression that the needle goes directly through the flesh.

Some, like the fakirs of India, make no attempt of fakery, but have a spectator lift a portion of the skin of the arm through which they plunge an unprepared needle. This is easily duplicated. All that is required is a needle that has been sterilized with an antiseptic, and plenty of nerve. Have the spectator lift a portion of the skin of the arm between two fingers, and boldly plunge the needle through this lifted part of the skin. The skin is tough and considerable pressure is required, but it will be found that there is practically no pain whatsoever as the needle passes through the skin and not through the flesh of the arm. When the needle is withdrawn the wound does not bleed, and leaves only a slightly smarting sensation. There is no danger from blood poisoning if a bright new needle that has been dipped in sterilizing liquid is used. Alcohol is a favorite antiseptic.

DANGEROUS METHODS

THERE is no danger connected with the use of hypnotism when one understands it thoroughly, but the reader must be warned never to experiment with the "instantaneous hypnotic" method sometimes seen, and which is positively injurious. I refer to the practice of nerve and muscle control, which is really not hypnotism at all, but a method of paralyzing the nerves and stopping the blood supply to the brain, which of course produces a temporary sleep, which is in reality a sort of paralysis.

One method consists in placing the arms around the chest of the subject and squeezing, while the subject maintains a lungful of breath. The other is the pressure on the

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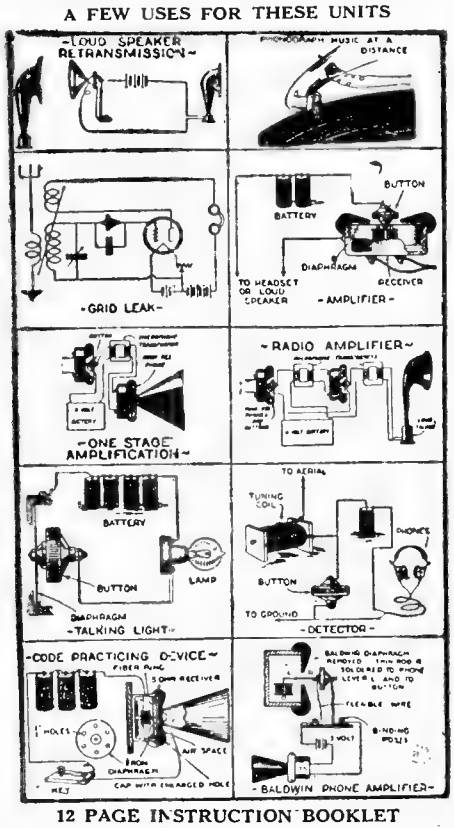

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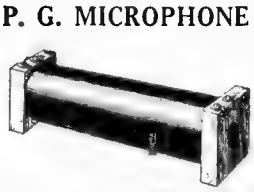

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nerve centers connecting with the brain, usually reached by pressing on the nerves underneath the chin, in a line with the eyes. Either of these practices are liable to cause permanent injury or paralysis; not so, however, with any experiments wherein the results are obtained solely by suggestions made by the performer.

It is frequently supposed that a person must be weak minded to become a hypnotic subject. Such is decidedly not the case. Neurotics, idiots and imbeciles are the most difficult to place in a trance because they will not or cannot concentrate. Don't try the effects on giddy people because you will be largely unsuccessful.

Inventors Ease Mothers' Cares
Continued from page 597)

ELECTRIC BOTTLE WARMER

A SMALL bottle warmer that is electrically operated has been invented. A little water is put in this and the nursing bottle is placed in the water. Then the current is turned on. When the water has boiled away, the milk is heated sufficiently for baby and the electricity is automatically shut off.

A combination baby walker, stroller, four-wheel coaster car and vehicle pushed by pedals has been invented. It grows with the child. It was made to fit the small baby and to provide suitable adjustments to maintain correct fit as the child grows older and bigger.

There is further a new combination of high chair, toilet seat, baby swing and auto seat into one, compact portable unit which suggested attention. Hung over the back of a chair, it makes a practical high chair for the baby. The child is supported by a tightly stretched cloth back and the chair is protected from scratches by presence of a rubber covered hanger and rubber guards. Thus a mother can have the baby in her sight in a high chair wherever she happens to be working. As a toilet seat, it can be used in two ways. By placing it over a large toilet where spacial rubber studs hold it in place, the child is held securely in the seat. By hanging it from a chair, with a chamber beneath, the baby has a comfortable seat and can be watched by the mother who is nor compelled, though, to leave other duties.

A swing attachment converts this unit into a baby swing, having springs that give it a gentle *jumper* motion that the baby enjoys. Placed in the angle of the auto seat, it fits into the upholstery by rubber studs which hold it securely. There are no straps or hooks.

SUN SUITS

SO-CALLED sun suits, very light clothing that gives plenty of chance for the health-giving rays of the sun to reach the skin, are being introduced in increasingly wide area. The U. S. Bureau of Home Economics of the Department of Agriculture has recently designed several kinds of clothing for kiddies and even little babies soon show what can be done in suits that promote health.

For children who cannot get out-of-doors and into the warm sun and for those who do not live where there is warm weather much of the twelve months, scientists have invented sun-lamps giving ultra-violet rays from quartz mercury lamps to help combat rickets and other enemies of the baby and small child. The results of this invention are seen in strong teeth and in good health of the babies using the treatment.

To flood the baby's room with health-giving sun-rays there has been placed on the market a so-called vita glass that permits the health-giving rays to pass.

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Don't think you have to fly to be a big success in Aviation. Good pilots draw substantial salaries—sure! But so do good mechanics, electricians, radio men, salesmen, instructors and many others. Aviation's best jobs aren't all up in the air—not by a long shot. For every plane that flies, there must be ten to forty highly paid, carefully trained specialists on the ground. Forget that Aviation was once considered a "game." Forget that just a short time ago it was still in its experimental stages. Instead realize that today it is the most efficient method of transportation the business world has ever known—and realize that within the next few years it is going to make thousands wealthy and put countless others on "easy street" for life.

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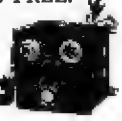

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PROMPT SERVICE—LOW PRICES

Over in London someone invented a motor baby carriage recently. Photographs sent back to this country showed a nurse riding along on the driver's seat and in the carriage, that looks like any other baby cab, are two babes. This vehicle is said to have been designed to go no faster than two miles per hour.

In London, too, there is a baby cab that is so made it should not tip over at a street crossing even though apparently thrown considerably out of balance. To promote safety for the baby, this cab was made securely fastened to the frame by springs instead of straps and so balanced that it is unlikely to tip where an ordinary carriage might.

A Chicago bachelor invented a baby carriage that can be rocked gently by an electric motor so that the nurse or the mother may attend to other matters while the baby is resting in the cab. It gives a rhythmic soothing motion to the cab, though not accompanied by a lullaby or so. The inventor is James Vicek of Chicago.

MISCELLANEOUS

A SPECIALLY designed spoon that the baby can easily put in the mouth without the difficulty usually encountered in managing one of the long-handled adult size spoons has been invented.

For the family where there is only one baby, a clever inventor has made a teter-toter that one can operate all alone. This has a spring to take the place of the second person on the teter-toter.

Little fenced-in play-yards of wooden construction are on the market for babies who need to get out on the porch or lawn to play while the mother attends to other duties without cause to be concerned for the safety of the baby. Some of these have sets of beads or blocks on the sides to help the baby learn to count or to spell or to recognize pictures.

PORTABLE POOL

A PUDDLE duck pool, a portable beach that can be placed on the lawn or on the floor, is made of canvas and in it the baby can splash about in the water, which can be made of the depth that the mother feels is safe. Thus the baby can move around in cool water on the lawn, with a protecting canvas on all sides to keep the infant from crawling away.

A portable seat that fits any toilet and which can be folded and carried in a bag or other small space has been invented for comfort of the baby when visiting away from home.

A toilet seat that can be carried anywhere has been designed especially for use on motor trips. This has a heavy paper insert that is discarded after use and that thus promotes health for the baby.

Several kinds of guards worn on the hands to prevent sucking of thumbs have been invented recently. This habit should be prevented, authorities say, because it favors mouth breathing and development of adenoid growths and causes deformities of the teeth and jaw.

A baby bottle sterilizer, recently invented, is placed in a saucepan containing a little water. Live steam and boiling water circulate within the bottle. The principle is the same in a general way as that which the coffee percolator employs.

There are now nursing bottles of glass that will stand extremes of cold and heat just as certain ovenware does. These do not roll, either, are easy to clean, and easy for the baby to hold. They remind of the bachelor inventor who thought he had a marvelous idea for a baby bottle that would not break—a nursing bottle of aluminum! And his friend, who was, laughed kindly and said: "But you see you have to be able to see through the bottle to see if the little codger is really drinking the milk."

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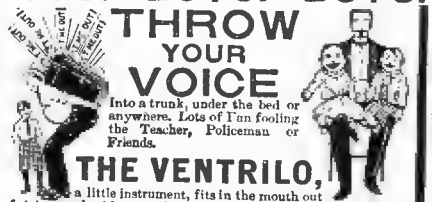

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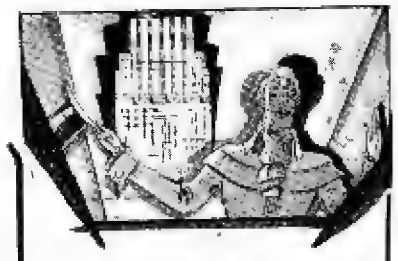

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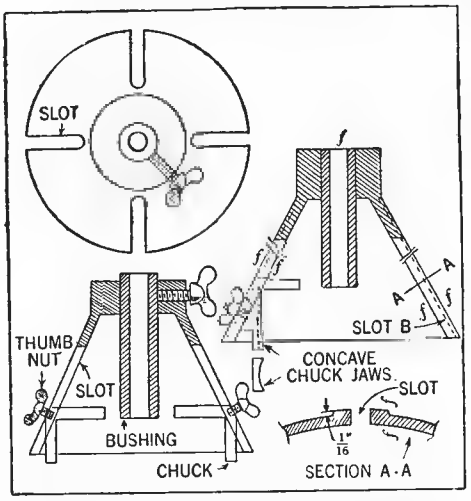
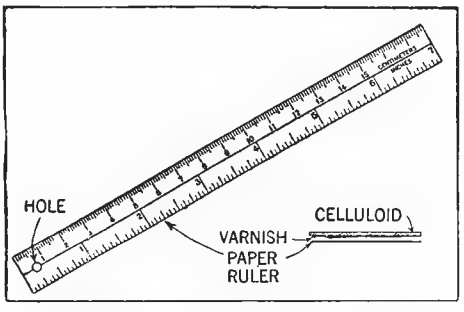
SLIDING CHUCK



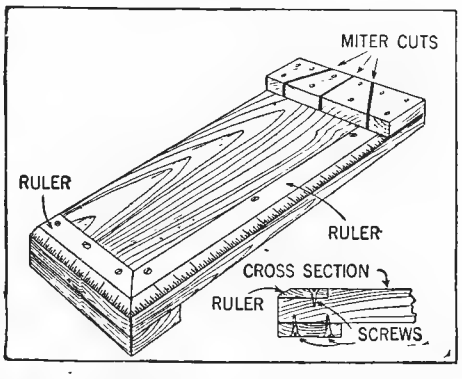
The above illustration gives the details for the construction of a sliding chuck which is adaptable to most lathes. With slots arranged as shown, it can be slid to any desired position and held in place by means of the thumb nuts. B designates the slots and a section through the line AA shows how they are fashioned. A raised portion 1/16-inch high parallels the slot on both sides.

"HANDY RULE"

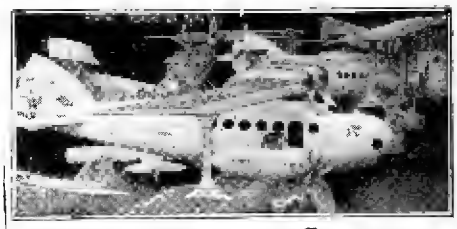


The small rule found on the index page in this magazine each month can be applied to celluloid. Wet and rub until layer of paper rolls off, allow to dry and paint on face with thin varnish. Place this face down on a piece of celluloid, allow to dry and trim edges.—Norvell C. Wood.

BENCH HOOK



The usefulness of a bench hook can be increased by sinking a rule along on edge and one side. These should be level with the top. Three cuts made in the end board furnish a very useful miter board. The above drawing shows how this can be accomplished. All the screw heads should be countersunk. The bench hook thus serves a triple purpose. —Herbert Erickson.



Aviation Brings Quick Success

TO young men of daring no other field of work offers such a fascination, such high pay, nor such opportunities for quick success as the field of Aviation. As yet, aviation is practically in its infancy. But now is the time to get in.

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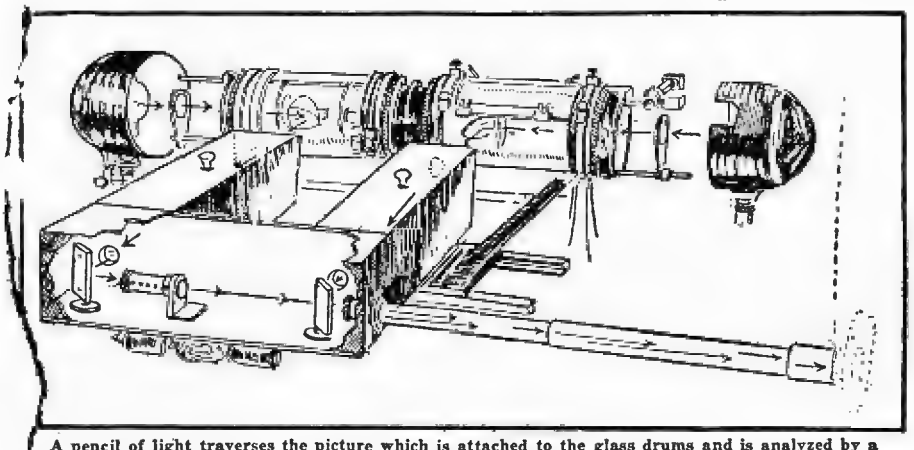
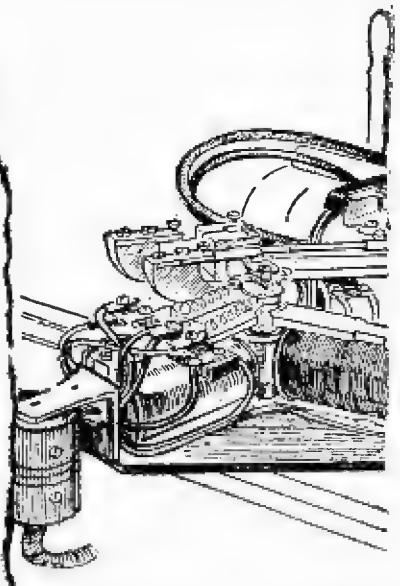
ransmission of Photo's by Radio

RANSMISSION OF PHOTOGRAPHS BY RADIO—Various methods have been devised and are now in use for the transmission of photographs by radio. Among these may be mentioned the systems of *Belin* (q.v.), *Baird*, and *Jenkins*. The principles underlying the Jenkins system are explained under the heading of *Television*. Using the system developed by Capt. R. H. Ranger, photographs were transmitted by radio from Honolulu to New York, a distance of 5,136 miles. Recently commercial picture transmission service has been inaugurated between New York and London using the Ranger apparatus. Two distinct methods have been applied for analyzing the picture in the process of transmission. One arrangement consists of producing an image as a non-conducting deposit upon a metal foil which is traversed by a stylus, while the other method makes use of an opaque image deposited upon a transparent film which is traversed by a beam of light, the light interruptions being recorded by a light sensitive cell. The Ranger system makes use of this latter method. The image is photographi... recorded upon a cel... to accom...



A pencil of light traverses the picture which is attached to the glass drums and is analyzed by a slow rotating action as well as a backwards and forwards movement of the carrier.

the electron flow constitutes a discharged circuit, so that the grid becomes less negative. The first amplifying tube is a direct current potential amplifier, and is resistance coupled. The grid and plate connections of the amplifier are connected across a condenser which becomes discharged with the fall in the grid to plate resistance of the valve brought about by the grid potential fluctuations. A charging circuit is connected to the condenser and is controlled by a valve, the grid circuit of which operates by variations of the potential across the condenser. The charging current is fed through the plate circuit of this valve, in which a relay is connected, which working through other mechanical relays in cascades, controls the radio transmitter. Wave trains from the transmitting station after detection and amplification, are applied to the picture recorder. The recording mechanism, in order that it may be sensitive to exceedingly small currents, comprises, a small moving coil, in a magnetic field created by three electromagnets. The coil of wire, in moving in the field, as the received fluctuations



recording mechanism of the receiver. Thi which a moving co

applied through its windings, ates a stylus while travelling ss the surface of the paper. The us traverses the paper in perfect chrony with the carriage of the nsmitter, the paper being lifted

S.Gernsback's Radio Encyclopedia

A facsimile of a portion of a page from S. Gernsback's Radio Encyclopedia is reproduced herewith. A glance at the thorough manner in which each item is treated cannot fail to instill a true appreciation of the value of the remarkable book. S. Gernsback's Radio Encyclopedia is the first ever published. It is not a dictionary. It covers every possible phase of radio. Every circuit, each piece of apparatus, all the leading characters of the industry, broadcasting, receiving, television, telephoto, everything connected even in the slightest way with the growth of radio or its kindred sciences, is most authentically explained. There are over 1930 separate definitions, 549 illustrations, a complete cross index, and many other special features. S. Gernsback's Radio Encyclopedia comes in two beautiful bindings, large 9 x 12 in. size

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HOME MOVIES

(*Continued from page 639*)

matic film and color filters providing a reproduction of scenic beauty that is entrancing.

There are many underwater scenes showing how pearls are gathered and also how the South Sea Islander gathers his meals from the sea. The native feast is truly educational, the preparation of the food being shown in detail, utilizing strictly native methods of preparation. There is one thing about this picture that is both new and novel, the *fade-out* at the end. Usually at the end of a photoplay the scene simply fades from view, but in this case—now we are not going to tell you how it is done. We want you to tell us, and to the reader of SCIENCE AND INVENTION who best and most completely describes how this effect was obtained, we will award a prize of a reel of 16mm. film, entitled "*Nonsensical News*." The contest is open to every reader except professional cameramen or others engaged in the production of professional pictures. Letters should be addressed to the "Fade-out Contest" Editor, SCIENCE AND INVENTION, 230 Fifth Avenue, New York City. Letters should be written on one side of the paper only and should not exceed 250 words in length. Entries must reach this office not later than October 25th, 1928 and the award of prizes will be announced in an early number.

Radio Movies Demonstrated

(*Continued from page 623*)

of the independent and more powerful plate current.

Thus the mercury arc lamp goes bright or dim as fast as the current changes, and its light at any instant is in proportion to the light that the electric eye sees in the same instant. To return the dots of light to their original pattern, another revolving disc or scanner is also used which is similar to the transmitting scanner.

The use of a mercury arc lamp permits the radio pictures to be thrown upon a ground-glass or screen, the first time this has been done with television apparatus.

Both these scanning discs turn at exactly the same speed; the hole in the receiving disc must be exactly in the same relative position as the corresponding hole in the transmitting disc. In other words, they must be synchronized.

RADIO WAVE USED TO SYNCHRONIZE DISCS

From the transmitting equipment, which may be located in the broadcasting station, there is transmitted a constant frequency wave of 5,000 cycles. This wave is produced by a tuning fork, and transmitted over a special carrier wave from the broadcasting station. The constant frequency note is received on a special receiver and by means of special apparatus controls the speed of synchronous motors, which drive the scanning discs of both transmitting and receiving radio movie equipment. This unique method of controlling the equipment indicates, in a measure, the extent to which science must go in order to perfect—say television, or radio movies.

It is stated that the regular transmission of motion pictures from KDKA will begin shortly; also that the radio movie reception apparatus, when produced commercially, will be sold through the regular trade connections.

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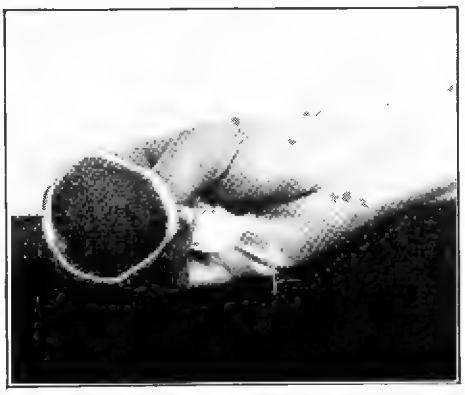
Wood Turning for the Amateur

By H. L. WEATHERBY

(*Continued from page* 614)



The above photograph shows the pad which is used in French polishing.

bottle so that the shellac comes in contact with the pad. In the same manner apply a small quantity of alcohol to the pad, followed by a drop or so of oil which is rubbed evenly over the pad.

WHEN this has been done, and with the work in motion, hold the pad lightly against the revolving piece. Gradually increase the pressure, but do not at any time bring enough pressure to bear so that the work or finish shows burning. The first coat should dry thoroughly before the second is applied. If too much oil is used the finish will not last. If too much shellac is used rings will occur or the work will be sticky and hard to manage. When rings do occur they may be cut off with a liberal application of the clear alcohol on the pad. A slight sprinkling of rotten stone will improve the polish as it is being applied, but too much of it will cut the gloss.

A French polish is rather difficult to apply, but when the method is mastered it will be found the most satisfactory way to finish turned articles. No other method comes up to it in results. One must learn by experience the right proportions to use on the pad, the correct pressure to apply and the number of coats necessary. Care must be taken to remove all oil from the last coat or the finish will dull in a short while.

With reference to other finishes; the author has always found rubbed finished particularly satisfactory on the lathe. It is simply a matter of finishing as in other cabinet work with filler, stain, shellac and varnish, but where the particular joy comes in is in the rubbing down process, which is such a laborious task if done by hand. On the lathe it is simply a matter of making up a pad, similar to the one used in French polishing and with pumice stone and oil and the article in motion a beautiful rubbed finish can be acquired in a fraction of the time required by hand. As a final finish, or after the final coat, rotten stone should be substituted for the pumice stone.

Alcohol, shellac, rotten stone, some cotton waste, a small oil can and a piece of cheese cloth are the only materials needed for the polishing.

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Science Probes Spiders' Secrets

By UTHAI VINCENT WILCOX

(*Continued from page 595*)

like him. They would leave to find a serious mate with another. Perhaps he just wasn't the marrying kind? In such a case, the moral breaks down. Love among the spiders is an absorbing thing, in which the ladies do the absorbing by making a wedding supper of their husbands. Thus the masher-spider would love and lose, and thus it may be that he chose to ignore the females when watching his friends as they were made into meals for the female.

These scientific facts, now being intensively studied by scientists, not only reveal these facts as to love and hate among insects but may throw some light on physical ability, engineering skill and the substance of spider's webs. What couldn't man do if he were able to make ropes and cables with the approximate strength of a spider's web. Suspension bridges would be thrown across on tiny cables about the size of binder's cords and, being light and easy to anchor, there would be no limit to their length. With the secret of making of cord after the manner of the wily spider, the whole course of engineering as we know it today would be altered!

It is the female spider that spins the web being provided for that purpose with six little tubes, called "spinnerets," at the end of her abdomen. Into these tubes open hundreds of glands, each of which supplies a separate thread, and the spider manipulates the threads by holding them between the "teeth" of her comblike claws.

Plane Broadcasts Radio Photo

(*Continued from page 624*)

witnessed by R. Sanford Saltus, Jr.; George W. Humpfer, electrical engineer of WFI; John G. Leitch, Federal radio inspector, and Robert P. Hewitt. The transmission was made from the plane while at an altitude of 5,000 feet. The plane was piloted by Robert P. Hewitt, assisted by John Buscher. The broadcasting apparatus was operated by John G. Leitch. A 65-foot fishline aerial was used for broadcasting, from the plane, and the entire program, including the picture signal impulses, were rebroadcast from WFI.

Although this is the first time that photographs have been transmitted by radio from an airplane, it is not the first transmission of photographs by radio. The first transmission of photographs by radio was accomplished in March, 1923, at which time pictures were broadcast from the Naval Radio Station, in Washington, and received at the Bulletin Building. This test was under the auspices of the North American Newspaper Alliance, in the presence of newspaper publishers and scientists. Pictures of President Harding, President Coolidge, and Gifford Pinchot were received. The distance between the transmitter and receiver was 130 miles. These pictures were transmitted using the Jenkins system, the invention of C. Francis Jenkins, of Washington, D. C.

One of the problems that had to be overcome in accomplishing this transmission was the elimination of the effect of the vibration from the Whirlwind motor, and this was accomplished by attaining a high altitude and running the motor with the throttle partly closed. The use of a phonograph record to avoid the use in the plane of the delicate and bulky "convertor" mechanism, is a typical example of the ingenious schemes devised by the engineers working on this problem.

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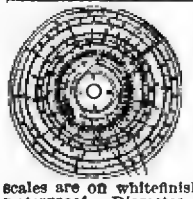

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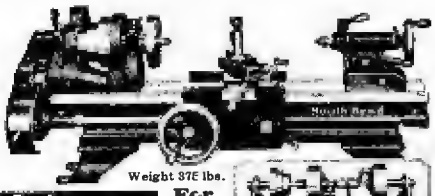

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How to Save Coal!

By C. D. KEELY

(*Continued from page* 592)

dows, present themselves. For an understanding of the proposition however, a thermally insulated building can be described as one in which has been isolated a portion of the heat that would escape were the structure uninsulated.

It is necessary to state here that the same insulation that keeps heat within a structure in winter, keeps heat out in summer; that is, helps to maintain the coolness that is created in consequence of the fact that the interior is shaded from the sun.

MATERIALS USED

Materials of many kinds now are available for thermal insulation. Some are made from diatomaceous earth, some of wood fibre, some of sugar cane fibre, some of gypsum, some of cork and others are made from seaweed. These all are different in physical character. Some are loose fillers, some are rigid boards, and some are quilts. They all, however, are applied to the same places, or in the same places, of a building; that is, they are applied to or in the walls, and under, or somewhere beneath, the roof. And the thermal insulating value of all of them is largely dependent on the same principle—dead-air cells. Walled up tightly in some material, tiny cells of dead air are the best known non-conductors of heat. All the materials mentioned, when in place, contain varying quantities of dead-air cells. Hence their value as insulators.

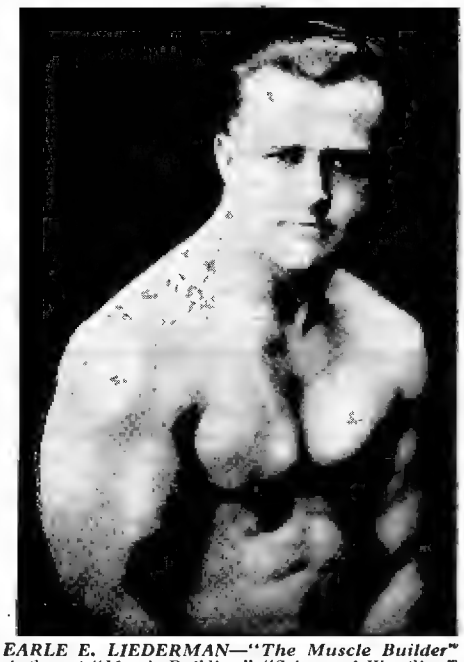
It was a search for an insulating material that possessed certain ideal qualities that developed rock insulation. The ideal qualities are: bulk without weight, low cost, ease of installation, permanence and fire-safety. Bulk without weight is important for this reason, it permits the installation of a sufficient amount of insulation to produce the maximum comfort and fuel saving. The importance of low cost, ease of installation, permanence and fire-safety, is, of course, obvious.

ROCK INSULATION

Rock insulation is manufactured in this manner: special, short length fibres are impregnated with ground gypsum, which is a light weight, incombustible rock. The finished product is a fluffy material that has been described as "mineral feathers." It is packed in paper bags, and is installed simply by pouring it in place from the sacks in which it comes.

Rock insulation, or as it more commonly is called, "gypsum dryfill," is installed inside walls, over the lath and plaster of ceilings, and under roofs. Its use as side walls is principally in connection with woodframe residence construction, where the walls are completely filled with gypsum dry-fill, which embeds the wood of the frame in an insulating, fireproofing material. Under roofs, the gypsum dry-fill is installed in one or two ways, either directly under the roof, as a backup for mineral wallboard, or rock lath; or between the attic joists where it is poured in such a way that it rests on the lath and plaster of the ceilings of the rooms below.

It is well to note again that gypsum dryfill simply is poured into place. It is not nailed, fitted, sawed or mixed with water. From the bags to the place to be insulated is all there is to its installation. And though the dry-fill itself is a fluffy, light weight substance, it does not dust or settle after it is in place. The gypsum impregnated fibres come together to form a blanket that contains myriads of tiny dead-air cells. (*Name of manufacturer on request.*)



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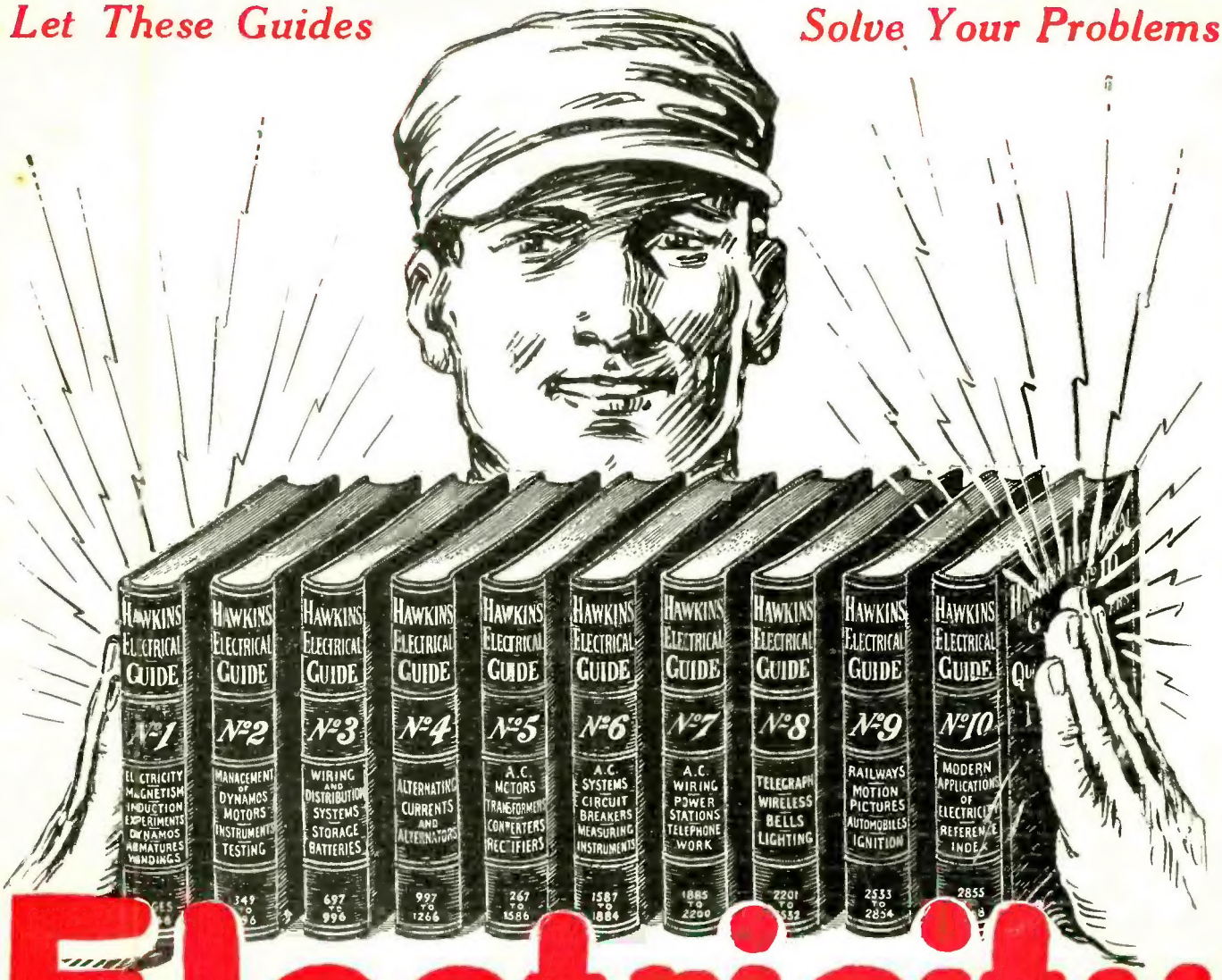
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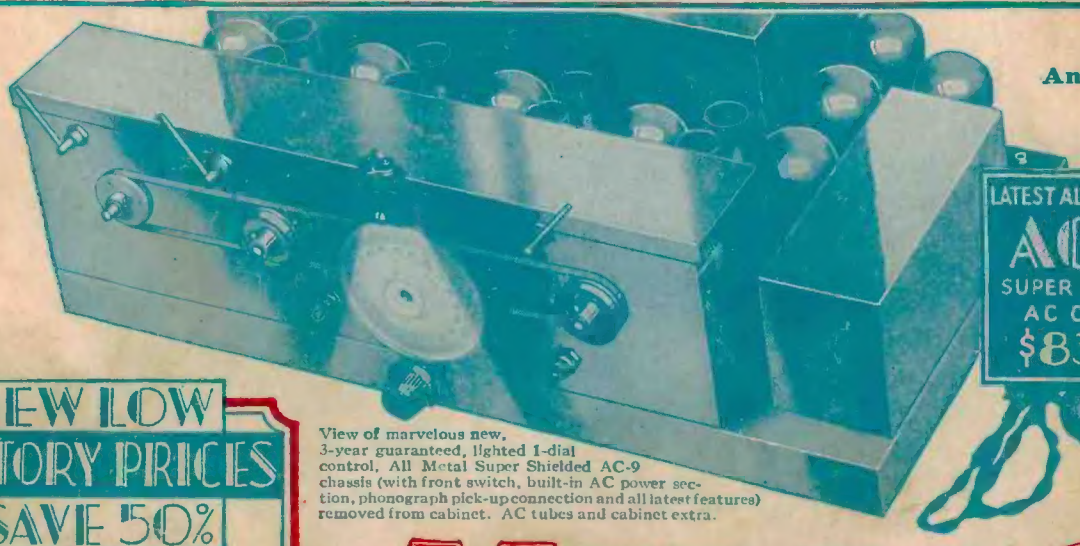

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